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Coal Tar, Creosote, and Coal Tar Neutral Oil Non-Wood Preservative Uses

Position Document No. 2/3

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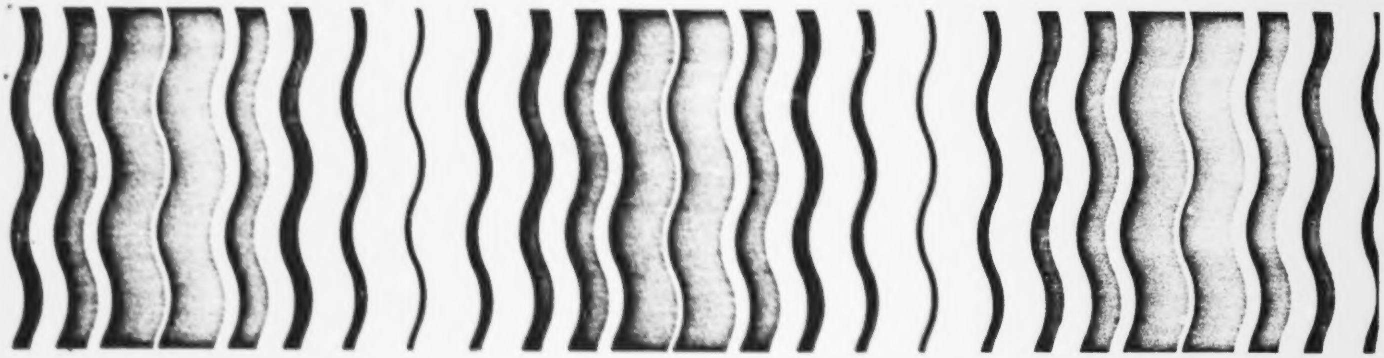

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This Position Document addresses the risks and benefits of pesticide products containing the subject active ingredient. The Agency has determined that the use of products containing the subject active ingredient may meet or exceed a risk criterion described in 40 CFR Part 154. Potential hazards will be examined further to determine the nature and extent of the risk, and considering the benefits of the subject active ingredient, whether such risks cause unreasonable adverse effects on the environment.

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NON-WOOD PRESERVATIVE USES

POSITION DOCUMENT NO. 2/3

Office of Pesticide Programs
Office of Pesticides and Toxic Substances
U.S. Environmental Protection Agency
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EXECUTIVE SUMMARY

Creosote, Coal Tar, and Coal Tar Neutral Oils- Non-wood Uses

Position Document 2/3

On October 18, 1978 EPA issued Notices of Rebuttable Presumption Against Registration and Continued Registration (RPAR) of pesticide products containing creosote, coal tar, and coal tar neutral oils. The presumption against these chemicals was based on validated studies showing that these compounds are oncogenic and mutagenic. In January, 1981 a Position Document 2/3 was issued that addressed the risks and benefits and proposed regulatory action of the wood preservative uses of creosote, coal tar, and coal tar neutral oils, as well as the inorganic arsenical compounds, and pentachlorophenol.

This document addresses the risks and benefits of the non-wood uses of creosote, coal tar, and coal tar neutral oils.

The non-wood uses of creosote, coal tar, and coal tar neutral oils can be divided into these general categories: herbicidal uses, fungicidal uses, insecticidal uses, and disinfectant uses. Approximately 2% of the amount of creosote produced annually is used for non-wood purposes. As a herbicide, creosote is blended with petroleum distillates and applied as a foliar spray on rights-of-way, industrial areas, fencerows, and on ornamental gardens and lawns to control nutgrass. Creosote and coal tar are registered for use to protect cordage and canvas from fungal attack or deterioration.

The insecticidal uses of creosote, coal tar, and coal tar neutral oils include use as a miticide, larvicide, ovicide, and repellent. Specifically, the uses include: control of animal parasites in animal quarters; treatment of gypsy moth egg masses; control of mosquito larvae; control of screwworms in horses and mules; treatment of seed to prevent ingestion by birds; animal dip to control parasites; and to control flies in drain lines and garbage trucks and containers.

The disinfectant uses of creosote, coal tar, and coal tar neutral oil include: to control fungi and bacteria in seed potato storage areas and equipment, poultry and livestock premises, and on tree wound dressings. Additionally, these products are registered for home and institutional use.

In reaching a proposed regulatory decision regarding the non-wood uses of creosote, coal tar, and coal tar neutral oils, the Agency evaluated rebuttal comments submitted in response to the PD-1 and public coments submitted in response to the PD-2/3 published on the wood uses of these chemicals.

The exposure data indicate that applicators of products containing creosote, coal tar, and coal tar neutral oils used for non-wood uses are subject to both dermal and inhalation exposure during the application process.

These products are applied by brush, spray, wiped on or the object/animal is dipped into the chemical. Two of the currently registered uses, on seed potato storage premises and equipment and on seed corn as a crow repellent, are considered food uses requiring the establishment of tolerances under Section 408 of the Federal Food, Drug, and Cosmetic Act. There exists a potential for dietary exposure as a result of these two uses. The livestock and poultry premise treatment uses are considered to be non-food uses.

The Agency has determined that the use of products containing creosote, coal tar, and coal tar neutral oils for non-wood uses poses a risk of oncogenicity and mutagenicity to the applicators. There is also potential risk as a result of dietary exposure to these chemicals through the two uses considered to be food uses as described above.

An analysis of the benefits associated with each registered use concludes that for the majority of uses viable, effective alternatives are available and in use. Several of the creosote, coal tar, and coal tar neutral oil products registered for non-wood uses are no longer marketed. Actual usage data for the creosote, coal tar, and coal tar neutral oil products are not available for most uses.

The following regulatory options were considered by the Agency in reaching the proposed regulatory decisions:

(1). Continuation of registration without changes.

(2). Continuation of registration with modification to terms and conditions of registration.

(3). Cancellation of registration.

Specific risk reduction modifications selected for further consideration under Option 2 are:

(1). Require protective clothing: impermeable gloves, respirators, coveralls; require proper disposal of protective clothing.

(2). Prohibit eating, drinking, and smoking during application.

(3). Restrict the sale and use of creosote, coal tar, and coal tar neutral oils to certified applicators or by persons under their direct supervision and only for those uses covered by the certified applicator's certification.

(4). Prohibit interior application.

Having evaluated the cancer and mutagenic risk associated with the non-wood uses of creosote, coal tar and coal tar neutral oil products, the Agency has determined that the continued, unrestricted registrations of these uses (Option 1) is unjustifiable and that the risks outweigh the benefits for both Options 1 and 2. Therefore, the Agency proposes to cancel the use of these products for all uses listed below:

Herbicidal uses

- Ornamental flowering plants and ornamental lawns
- Product storage yards
- Agricultural premises and highway rights-of-way

Fungicidal uses - rope and canvas

Disinfectant uses

- Livestock premises
- Poultry premises
- Home and institutional uses
- Transportation vehicles
- Tree wound dressings
- Metalworking fluids
- Seed potato storage premises and equipmment

Use as larvicide, insecticide, repellent

- Mosquito larvicide
- Insect repellent
- Animal repellent
- Screwworm control
- Bird repellent
- Insect control
- Animal dip
- Gypsy moth egg mass control

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PART I. INTRODUCTION

A. General Background and Organization

The Federal Insecticide, Fungicide, and Rodenticide Act as amended (FIFRA) and its regulations require the Environmental Protection Agency (EPA) to review the risks and benefits of uses of pesticides. On October 18, 1978 EPA issued Notices of Rebuttable Presumption Against Registration and Continued Registration (RPAR) of pesticide products containing coal tar, creosote, and coal tar neutral oils, inorganic arsenical compounds, and pentachlorophenol. The presumption against coal tar, creosote, and coal tar neutral oils was based on validated studies showing that these compounds are oncogenic and mutagenic. Position Document 1 (PD-1) issued with the Notice of Rebuttable Presumption describes these studies in detail.

In January, 1981 a Position Document 2/3 (PD-2/3) was issued that addressed the risks and benefits of the wood preservative uses of creosote, coal tar, and coal tar neutral oils, the inorganic arsenical compounds, and pentachlorophenol.

This Position Document 2/3 addresses the risks and benefits of the non-wood preservative uses of creosote, coal tar, and coal tar neutral oils. The non-wood preservative uses of the inorganic arsenical compounds and pentachlorophenol will be considered in future position documents.

This document contains five parts. Part I is this introductory section. Part II evaluates the potential risks associated with the non-wood preservative uses of creosote, coal tar, and coal tar neutral oils. Part II also includes descriptions and evaluations of the risk evidence, exposure data, rebuttal submissions, and the Agency's risk assessment. Part III estimates and summarizes the economic benefits of the nonwood uses of these chemicals for each use category and describes the assumptions and limits of these estimates. Part IV describes the range of possible regulatory options and modifications to reduce the risks so that they are exceeded by the benefits of these pesticides, and explains the Agency's selection of some of these options for further consideration. Part V evaluates the specific impact on the risks, benefits, and other effects which would occur if each applicable option and modification for each use category were adopted and presents the options and modifications selected for further consideration by the Agency.

B. Legal Background

To obtain a registration for a pesticide under the Federal Insecticide, Fungicide, and Rodenticide Act ("FIFRA"), as amended, an applicant for registration must show that the pesticide satisfies the statutory standard for registration. That standard requires, among other things, that the pesticide perform its intended function without causing "unreasonable adverse effects on the environment" FIFRA §3(c)(5).

The term "unreasonable adverse effects on the environment" is defined as "any unreasonable risk to man or the environment, taking into account the economic, social and environmental costs and benefits of the use of any pesticide" FIFRA § 2(bb). To register a pesticide, the administrator must find that the benefits of each use of the pesticide exceed the risks of use, when the pesticide is used in accordance with commonly recognized practice and in compliance with the terms and conditions of registration.

The burden of proving that a pesticide satisfies the registration standard is on the proponents of registration and continues as long as the registration remains in effect. Under section 6 of FIFRA, the Administrator may cancel the registration of a pesticide or modify the terms and conditions of registration whenever it is determined that the pesticide causes unreasonable adverse effects on the environment. The Agency created the RPAR process to facilitate the identification of pesticide uses which may not satisfy the statutory standard for registration and to provide an informal procedure to gather and evaluate information about the risks and benefits of these uses.

The regulations governing the RPAR process are set forth in 40 CFR the 162.11. (The RPAR process has been newly named the Special Review Process"). Among other things, this section provides that a rebuttable presumption against registration shall arise if a pesticide meets or exceeds any of the risk criteria set out in the regulations. The Agency announces the commencement of the RPAR process by publishing a notice in the Federal Register. After an RPAR is issued, registrants and other interested persons are invited to review the data upon which the presumption is based and to submit data and information to rebut the presumption by showing that the Agency's initial determination of risk was in error, or by showing that use of the pesticide is not likely to result in any significant exposure to humans or the environment with regard to the adverse effects in question. In addition to submitting evidence to rebut the risk presumption, respondents may submit evidence as to whether the economic, social and environmental benefits of the use of the pesticide outweigh the risks of use.

In determining whether the use of a pesticide poses risks which are greater than the benefits, the Agency considers possible changes to the terms and conditions of registration which can reduce risks, and the impacts of such modification on the benefits of use. If the Agency determines that such changes sufficiently reduce risks to the level where the benefits outweigh the risks, it may conclude the RPAR process. The Agency announces this type of conclusion to an RPAR review by publication of a Notice of Determination in the FEDERAL REGISTER. That Notice states and explains the rationale for the Agency's regulatory position, provides that the registrant may avoid cancellation by implementing the modifications to the terms and conditions of registration set forth in the Notice, and sets forth the hearing rights of the affected parties.

C. Chemical Background

1. Chemical and Physical Characteristics

Creosote and coal tar are extremely complex mixtures containing hundreds of identifiable constituents. These mixtures are produced by the high temperature carbonization of coal, a process referred to as coking.

Coal tar is a black, viscous liquid or semi-solid with a naphthalene-like odor and a sharp burning taste. It is combustible and has a specific gravity of 1.18-1.23 (60/60°F). Coal tar is soluble in benzene, carbon disulfide, chloroform, and is partially soluble in alcohol, acetone, and methanol. Coal tar is only sightly soluble in water (EPA, 1978).

Creosote and neutral oil are products derived from coal tar. Both creosote and neutral oil may be distilled from sources other than coal, but the terms "creosote" and "neutral oil" in this document will refer to distillates of coal tar. Creosote is a yellowish to dark brown oily liquid with a naphthalenic odor and frequently contains substantial amounts of naphthalene and anthracene. The distilling range of creosote is between 200-400°C. Creosote is soluble in alcohol, benzene, and toluene and immiscible with water.

Coal tar neutral oils are generally defined as a mixture of naphthalene, fluorene, anthracene, and other neutral hydrocarbons. Neutral hydrocarbons are those coal tar hydrocarbons other than coal tar acids (such as phenols, cresols, and cresylic acids), and coal tar bases (such as pyridines, quinolines, and acridines).

The actual constituents of coal tar, creosote, and the neutral oils are highly variable. They depend on the source of the coal used to produce tar, the design and attendant operating conditions (temperature, coking time, gas collection), systems of the coke ovens, and in the case of the coal tar distillates the design and operating parameters of the still (EPA, 1978).

Over three hundred compounds have been positively identified in coal tar. It is estimated that as many as ten thousand compounds may exist, though many are present only in trace amounts (EPA, 1978). Because the composition of coal tar and coal tar products is known to vary, they are usually assayed and specified by their physical characteristics.

2. Use and Production

The non-wood preservative uses of creosote can be divided into the following general categories: herbicidal uses, fungicidal uses, insecticidal uses, and disinfectant uses. Approximately 2% of the amount of creosote produced is used for non-wood preservative uses. Therefore, the uses described below are minor compared with the major uses of creosote as a wood preservative.

As a herbicide, creosote is blended with petroleum distillates and applied as a foliar spray on rights-of-way, industrial areas, fencerows, roofs and on ornamental lawns to control nutgrass.

Creosote and coal tar are registered for use to protect cordage and canvas from fungal attack or deterioration.

The insectidical uses of creosote, coal tar, and coal tar neutral oil include use as a miticide, larvicide, ovicide, and repellent. Specifically, the uses include: control of animal parasites in animal quarters; treatment of gypsy moth egg masses; control of mosquito and fly larvae and screwworms in horses and mules; treatment of seed to prevent ingestion by birds; animal dip to control parasites; and to control drain flies and flies on garbage containers and garbage trucks.

The disinfectant uses of creosote, coal tar, and coal tar neutral oil include: control fungi and bacteria in seed potato storage areas and equipment, poultry and livestock premises, tree wound dressings, and metalworking fluids. Additionally, these products are registered for home and institutional use.

3. Tolerances

The Agency has established no tolerances or exemptions from tolerances, and the U.S. Food and Drug Administration (FDA) has established no action levels for creosote in or on raw agricultural commodities. Under the provisions of 21 CFR, the FDA has not established an indirect food additive regulation for holding, transporting, or packaging raw agricultural products (EPA, 1981).

II. RISK ANALYSIS AND ASSESSMENTS

This part of the Position Document is divided into five sections. The first two sections discuss the rebuttal comments received in response to PD-1 and the public comments received in response to Position Document No. 2/3: Wood Preservatives (PD-2/3). The bases of the Agency's presumption against registration of creosote, coal tar, and coal tar neutral oils and the Agency's response to the rebuttals and public comments are included in these sections. For creosote, coal tar, and coal tar neutral oils, the rebuttable presumption against registration was issued on the basis of oncogenicity and mutagenicity.

The third and fourth sections address human exposure to these chemicals for the various non-wood preservative uses. The final section presents the risk assessment for oncogenicity and mutagenicity.

In assessing the risks associated with a chemical, two factors are considered: the toxic effect(s) of the pesticide and the amount of exposure to the pesticide. The toxic effects of concern for creosote were described in PD-1 as the basis for the rebuttable presumption.

A. Basis of Presumption and Analysis of Rebuttal and Public Comments Concerning Mutagencity

1. Basis of Presumption

In the studies summarized in PD-1 on creosote, coal tar, and coal tar neutral oils as well as studies that have been reviewed since the issuance of the PD-1, mutagenic effects of creosote and coal tar/creosote were studied in *Salmonella typhimurium* strains and in L5178Y mouse lymphoma cells. In both cases, these chemicals, upon metabolic activation, produced dose-related increases in mutagenic activity.

The results of these studies performed in submammalian and mammalian test systems are summarized below.

Submammalian Test Systems

Dose-related mutagenic responses were found in experiments for both creosote and creosote-coal tar using the standard Ames *Salmonella* plate test (Simmon and Poole, 1978; Simmon and Shepherd, 1978; and Bos *et al*., 1983).

In experiments conducted at SRI, dose-related mutagenic responses in three separate experiments were found for both

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creosote and creosote-coal tar using the standard Ames Salmonella plate test. Responses were roughly linear in the concentration range of approximately 5 to 100 ug of test material per plate, assuming a density of 1 g/ml. The maximum increase in numbers of revertants per plate was approximately tenfold over background numbers. At concentrations of about 100 ug/plate, the responses level off, and then at higher concentrations the revertant counts decrease to zero as toxicity of the test material becomes an important factor of the test (Simmon and Poole, 1978; Simmon and Shepherd, 1978).

SRI observed positive responses for the frameshift-sensitive test strains TA1538, TA98, TA1537, and TA100, but not the base-pair substitution sensitive strain TA1535. Mutagenicity was detected only in the presence of an exogenous source of mammalian metabolic activation (S9 mix prepared from livers of Aroclor 1254-induced rats). The production of frameshift mutations and the requirement for metabolic activation are consistent with Salmonella studies of individual polycyclic organic compounds identified in creosote and creosote-coal tar. (Simmon and Poole, 1978; Simmon and Shepherd, 1978).

Bos et al. (1983) evaluated small increases in concentration (2,5,20, and 50 ug/plate) and found that creosote (type P-1) caused a dose-related mutagenic response in Salmonella tester strains TA1538, TA98, TA1537, and TA100, but not in TA1535 using the standard plate test. The mutagenic responses were detected in the presence of Aroclor 1254-induced rat liver S9 but not in its absence. The maximum increase in numbers of revertants per plate above the background number was approximately tenfold (background number of revertants was within acceptable range). In addition, these investigators added an epoxide hydratase inhibitor (1,1,1-trichloropropane-2,3-oxide) to their test and enhanced the mutagenic effects of creosote twofold. Because this inhibitor enhances the mutagenicity of benzo[a]pyrene by accumulation of an epoxide intermediate, it is speculated by these investigators that polycyclic aromatic hydrocarbons (PAHs) contribute to the mutagenicity of creosote.

Litton Bionetics, Inc. (LBI) originally reported creosote (type P-1) and creosote-coal tar (type P-1, Class C) to be negative in the Ames Salmonella plate test but obtained positive results upon retesting. In the initial experiments, large increments in concentration (1, 10, 100, 1000, 5000 ug/plate) were tested. Mutagenic responses may have been missed because of toxicity or because the test materials are viscous materials that are relatively insoluble and technically difficult to test (Nesnow, 1979). Dr. David Brusick of Litton Bionetics, Inc. suggested that the negative responses initially reported may been due to "the quality of S9 mix preparations " (LBI, 1978 a,b).

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It should be noted that the positive controls requiring metabolic activation were clearly mutagenic. In the retesting experiments using creosote (type P-1), mutagenic responses in TA1537 and TA98, several times over background levels, were observed at 100 ug/plate in the presence of Aroclor-1254 rat liver S9 mix.

Mammalian Test Systems

Only one gene mutation study using mouse cells in culture was available for review. (Mitchell and Tajiri, 1978). This study was an *in vitro* mammalian mutagenesis assay. Mouse lymphoma cells (L5178Y), heterozygous at the thymidine kinase locus (TK+/-), were used both with and without by Aroclor 1254-induced rat liver homogenate (S-9 fraction) for activation. The purpose of these tests was to determine the mutagenic activity of creosote and coal tar/creosote on the forward mutation frequency of the TK locus from heterozygous (TK+/-) to homozygous (TK-/-). Ethyl methane sulfonate was used as a positive control in the creosote experiments, and dimethylnitrosamine was the positive control in the coal tar/creosote experiments. For each concentration of test chemical, the mutation frequency results were calculated as the ratio of the number of mutant cells to the total number of surviving cells. The induced mutation frequencies for the tested compound are obtained by subtracting the negative control's average mutation frequency from the treated sample's mutation frequency.

Creosote and coal tar/creosote had similar effects on the forward mutation frequency at the TK locus of the L5178Y mouse cells, both with and without metabolic activation. Dose-related increases in mutation frequencies were reported for both test chemicals following metabolic activation. However, without metabolic activation, the mutation frequency in the creosote tests was reported to be weakly positive at the highest concentration, whereas the experiments with coal tar/creosote resulted in increases in the frequency of mutations at the two highest concentrations (Mitchell and Tajiri, 1978).

2. Analysis of Specific Rebuttal and Public Comments Concerning Mutagenicity

The comments and respective Agency responses that follow are rebuttals submitted in response to the PD-1 on creosote, coal tar, and coal tar neutral oils. These rebuttals were previously published in the PD-2/3 (EPA, 1981) on the wood preservative use of creosote, coal tar, and coal tar neutral oils and are included in this document for completeness. The number in parentheses after the title of each comment is an internal number assigned to each comment received. A list of the comments is in Appendix A of this document.

Rebuttal Comment 1: Reliability of the Results of Simmon and Poole, 1978 (2)

The American Wood Preservers Institute .AWPI) submitted two unpublished microbial studies performed by Litton Bionetics, Inc. (LBI, 1977, 1978) to invalidate the gene mutation results of Simmon and Poole (1978). LBI, using the same assay (Ames Salmonella test) as Simmon and Poole, twice investigated the mutagenic potential of creosote and coal tar/creosote.

The rebutter considered the first Litton study (1977) to be negative; the second Litton study (1978) was positive. The rebutter's explanation for the positive results in 1978 was that the creosote may have aged and/or the rat liver preparation was different from that used in 1977. The rebutter states that the results of LBI's experiments show that those of Simmon and Poole cannot be relied upon as establishing the potential for human mutagenicity of creosote mixtures.

Agency Response: The Agency has reviewed the two studies submitted by the rebutter and concludes that, although LBI's 1977 mutagenicity assays performed with microbial systems were generally negative, the S. typhimurium strain TA 100 demonstrated a positive response. This strain, when tested in 1977 with metabolic activation by rat liver preparations, was positive for mutagenicity in one experiment and negative in another experiment. These conflicting results were not explained by the authors; however, it is unclear whether the same sample of creosote was analyzed and if the same rat liver preparation was used.

The Agency agrees that it is possible that there may have been differences in the rat liver preparations used in the studies. These differences could have been caused by different dose levels of Aroclor given to the rats, resulting in different activation characteristics of the rat liver preparations. (The doses were not reported by LBI.) As for the possibility of mutagenic products being formed upon aging of the creosote, this aging process will also undoubtedly occur in coal tar/creosote treating solutions.

Consequently, the Agency cannot accept the argument that because LBI's tests showed some degree of indeterminance the experiments performed by Simmon and Poole (1978) are invalid. The Agency concludes that the LBI 1977 study indeed showed a positive result for S. typhimurium TA 100, and the 1978 LBI study also showed positive results for S. typhimurium TA 1537 and TA 98. Thus, the Agency does not consider LBI's results to be negative, as does the rebutter, nor that these results conflict with those reported by Simmon and Poole (1978). Thus, the Agency concludes that the data of Simmon and Poole are valid and supportive of the presumption of mutagenicity.

Rebuttal Comment 2: Reliability of the Results of Mitchell and Tajiri, 1978 (2)

The AWPI claims that the study of Mitchell and Tajiri (1978) is unreliable for the purpose of demonstrating potential human mutagenicity of creosote mixtures. This is due primarily to the difficulty of interpreting the results of these experiments where only weak mutagenic activity is observed at the higher doses of creosote that caused pronounced cytotoxicity. The rebutter believes that observed mutagenic effects are only valid when a 10% or greater survival rate occurs in the detector cells treated with three increasing doses. Because the Mitchell and Tajiri study did not meet these criteria, the rebutter believes the results of this study are difficult to interpret.

In support of this position, the rebutter submitted an unpublished study. In these experiments, diploid human embryonic lung tissue was used to study the unscheduled DNA synthesis (UDS) caused by coal tar/creosote. These results showed evidence of weak mutagenicity at high (cytotoxic) levels of creosote.

Agency Response: The Agency agrees that the occurrence of cytotoxicity complicates the interpretation of the mutagenic responses observed by Mitchell and Tajiri (1978). However, even though the cytotoxicity is higher than desirable and masking of the mutagenic response (e.g., due to the selective killing of mutants or simply due to a low survival rate of all test cells) may have occurred, the Agency concludes that the Mitchell and Tajiri study demonstrated the mutagenicity of creosote mixtures in the test system.

The Agency has reviewed the study submitted by the rebutter and concludes that the LBI's results are consistent with those of Mitchell and Tajiri, showing that creosote induces unequivocal, albeit weak, unscheduled DNA synthesis in human diploid WI-38 cells in the presence of rat liver preparations.

Rebuttal Comment 3: Insufficient Data to Meet EPA's Guidelines for Multitest Evidence (2)

The AWPI submitted the results of LBI experiments in which creosote mixtures were tested in five microbial systems. In all cases the results were negative for mutagenicity. The rebutter believes these results show creosote does not meet the RPAR risk criteria.

Agency Response: To meet the RPAR risk criteria for potential mutagenicity [40 CFR, Section 162.11(a)(3)(ii)(A)], a chemical must be shown to cause gene mutations in at least two of the thirteen test systems listed in the Proposed Guidelines [40 CFR, Section 163.84(b)(2)(i-iii)]. As it is stated in the Agency's proposed guidelines [40 CFR Part 163 (III)(G)], "A compound would be considered a mutagen if it produced positive results in: two different kinds of tests for demonstrating gene mutations; a mouse specific locus test; or any kind of test for demonstrating chromosome aberrations." The positive results of Simmon and Poole (1978) and Mitchell and Tajiri (1978) provide more than sufficient evidence for meeting the mutagenicity criteria of the Guidelines. In addition, the positive results from the *Salmonella* assays and the human cell study (both submitted by this rebutter; see rebuttal comments 1 and 2) further support the presumption of mutagenicity.

Since two different kinds of tests (Simmon and Poole, 1978; Mitchell and Tajiri, 1978) showed positive results for mutagenicity of coal tar/creosote solutions, the *five* additional LBI studies showing negative results, although adding to the Agency's data base, do not rebut the presumption of mutagenicity in PD-1.

It should be noted that these negative studies, which were tests in submammalian systems, are inadequate studies and not considered supportive of the non-mutagenicity of creosote. Moreover, the effectiveness of these submammalian assays for evaluating complex mixtures has not been determined, unlike the *Salmonella* assay.

Rebuttal Comment 4: Bacterial Cell Membrane Uptake of Creosote (2)

The AWPI asserts that the *Salmonella* strains used by Simmon and Poole (1978) are *inappropriate* for mutagenicity testing. This is because the cell membranes of these strains have a specific "defect" allowing greater uptake of polycyclic aromatic hydrocarbons (PAH's) than other cell membranes.

Agency Response: The Agency agrees with the rebutter that the *Salmonella* strains used in the Ames assay have an increased permeability toward the large heterocyclic molecules. These strains are used intentionally to mimic the permeability of mammalian cells as much as possible. This is also true for the *Bacillus subtilis* strain (used by LBI), which may have a permeability to heterocyclic compounds greater than that of the *S. typhimurium* strain used by Simmon and Poole. The Agency concludes that the *Salmonella* strains used by Simmon and Poole are appropriate for mutagenicity testing.

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Rebuttal Comment 5: Appropriateness of Rodent Liver Homogenates for Activating Creosote Mixtures (2)

The AWPI states that rodent liver enzymes are inappropriate for activating creosote mixtures prior to the Ames *Salmonella* test. The metabolic activity in rodent liver is much greater than that in either human skin tissue or human liver. The rebutter also points out that qualitative, as well as quantitative, differences exist between rodents and humans with regard to the metabolic pattern of polycyclic aromatic hydrocarbons (PAH's). Consequently, as specific metabolites of PAH's may be the actual mutagens, a PAH may produce mutagenicity in one species (e.g., rodents) and not in another (e.g.. humans).

Agency Response: The Agency agrees that there are some qualitative and quantitative differences in enzymatic activity between rodent liver preparations used in the *S. typhimurium* mutagenicity assays and preparations from human liver or skin tissue. However, the bacterial mutagenicity assay is commonly used by scientists as a primary screening test for chemicals which have mutagenic potential. A positive result in these bacterial mutagenicity assays, although not intended to be the sole basis from which an extrapolation is made to a more complex biological endpoint (e.g., human mutagenicity), does indicate, however, that the presumption of mutagenicity for creosote and coal tar/creosote is not rebutted.

Rebuttal Comment 6: Extrapolation from *In Vitro* Experiments to Human Mutagenicity (2)

The AWPI points out that complex factors limit extrapolation from *in vitro* mutagenicity experiments to *in vivo* human mutagenicity.

Agency Response: The Agency agrees that it is difficult to extrapolate from *in vitro* mutagenicity to *in vivo* human mutagenicity. However, as discussed above (rebuttal comment 5), *in vitro* experiments like those of Simmon and Poole (1978) are intended to provide a rapid screening device for substances that have a potential human mutagenic effect. The results of the *S. typhimurium* assay are used in this document merely for qualitative purposes.

Rebuttal Comment 7: Potential for Nonsomatic Cell Mutations (2)

The AWPI states that although bacterial mutagenicity assays may be relevant to skin tumors, the potential for nonsomatic (germ) cell mutations is slight, since these cells are distant from the site of contact with creosote and the creosote is not likely to be systemically distributed throughout the body.

Agency Response: The Agency rejects the assumption that creosote is not likely to be systemically distributed throughout the body. Studies performed by Ames et al. (1973) showed that when certain compounds are applied to the scalp of humans, they are ultimately found in the urine. Therefore, some compounds entering by dermal and/or inhalation routes may not necessarily stay at the site of contact but may be carried by the blood to other parts of the body. Whether this fails to occur with creosote can only be determined by experiments.

The following comments were submitted to the Agency in response to the Position Document No. 2/3 on the wood preserving uses of creosote, inorganic arsenicals, and pentachlorophenol.

Comment Issue 1: Microbiological assays as evidence of creosote mutagenicity

The AWPI judges the Salmonella experiments of Simmon and Poole (1978) as unreliable evidence of the mutagenicity of creosote/coal tar because of the contradictory results found by Litton Bionetics, Inc. (LBI) (1978a, 1978b, 1978c) in the Salmonella microsome assay for this complex mixture. The AWPI states that these contradictory results indicate the "inherent weakness" of the Salmonella (Ames) assay in predicting creosote/coal tar mutagenicity.

Agency Response: Simmon and Poole (1978) as well as Simmon and Shepherd (1978) were able to demonstrate in three independent experiments using Salmonella with exogenous metabolic activation that creosote/coal tar caused a dose-related increase in frameshift mutations. Recent studies by Bos et al. (1983) confirm these positive findings (Vaughn-Dellarco, 1983). Therefore, the Agency concludes that the results of Simmon and Poole (1978) as well as Simmon and Shepherd (1978) provide acceptable evidence for the mutagenicity of creosote/coal tar in Salmonella.

In general, the Salmonella test has been effective in the evaluation of many different environmental complex mixtures, such as tobacco smoke condensates, drinking water, soot from city air, fly ash, and other combustion products. One major problem in evaluating the potential mutagenicity of complex mixtures, however, is their toxicity to the test organism. Creosote/coal tar is no exception in that toxicity to Salmonella presents a testing problem. Because of the toxicity of creosote/ /coal tar, the mutagenic activity was only demonstrable within a narrow concentration range. Responses in the Simmon and Poole (1978) and Simmon and Shepherd (1978) studies were roughly linear from approximately 5 to 100 ug/plate. Nesnow (EPA,1979) also indicated that this heterogenous mixture is toxic to Salmonella and is technically difficult to study (Vaughn-Dellarco, 1983).

Thus, the contradictory (negative) results reported by LBI (1978a, 1978b, 1978c) may reflect the difficulties in testing creosote/coal tar. LBI only evaluated log intervals that covered a large concentration range, and thus could have missed a positive response in their initial 1978 experiments because of toxicity. Also, after a Salmonella retest of the material, Bresick (1978) concluded that creosote/coal tar is mutagenic and that attempts to repeat the negative results originally reported by LBI were unsuccessful. Brusick (1978, 1981) attributed the negative results in the earlier experiments to the quality of the S9 preparations used (Vaughn-Dellarco, 1983).

Comment Issue 2: Mouse lymphoma studies as evidence of creosote mutagenicity

The AWPI (36A) argued that the experiments of Mitchell and Tajiri (1978) do not demonstrate the mutagenicity of creosote/coal tar in mouse lymphoma cells in vitro because mutagenic activity was found only at concentrations that were toxic.

Agency Response: The Agency acknowledges that there is debate among investigators who use the mouse lymphoma TK +/- assay as to whether data collected at 10% survival are acceptable for evaluating the mutagenicity of a chemical substance. However, Mitchell and Tajiri (1978) demonstrated a significant ($P < 0.001$) dose related increase in mutagenic response in a study using eight dose points. At concentrations that resulted in approximately 11%-15% total relative growth, weak mutagenic responses were detected (i.e. approximately a twofold increase in the spontaneous mutation frequency (Vaughn-Dellarco, 1983). Consequently, the Agency considers the results of Mitchell and Tajiri as evidence that creosote/coal tar is mutagenic in mouse lymphoma cells when an exogenous source of hepatic metabolic activation was added.

The results in the mouse lymphoma TK +/- assay strongly suggest that creosote/coal tar is mutagenic in mammalian cells in culture. The toxicity of the complex mixture to the cells may mask the mutagenicity of components present a low concentrations, thus the results may underestimate the mutagenic potential of this material. Therefore, the results in the mouse lymphoma TK +/- assay strongly suggest that creosote/coal tar is mutagenic in mammalian cells in culture (Vaughn-Dellarco, 1983).

Comment Issue 3: Extrapolation of creosote mutagenicity bacterial test results to humans

The AWPI (36A) states that it is inaccurate to extrapolate the results from bacterial test systems to conclude that creosote/coal tar is a human mutagen.

Agency Response: The Agency agrees that it is not accurate to extrapolate directly from bacteria to the likely human response and classify any chemical substance as a "human mutagen." The purpose of *in vitro* tests, such as the *Salmonella* assay, is to screen chemicals for their potential mutagenicity and/or carcinogenicity. The Agency's conclusion is that the weight-of-evidence (i.e., positive data derived from *in vitro* tests in bacteria and mammalian cells as well as data regarding the mutagenic and/or carcinogenic activity of the individual components of creosote/coal tar) suggest that creosote/coal tar have the potential to cause mutations in humans and not that creosote/coal tar is a human mutagen (Vaughn-Dellarco, 1983).

It is recognized that creosote/coal tar was evaluated in *in vitro* tests only. When evaluating the risk posed by exposure to a mutagenic agent, several factors, including absorption and metabolism, may alter mutagenic response in a mammal compared to that in *in vitro* tests. Although *in vivo* studies in mammals are necessary to better characterize the risk of creosote/coal tar, this does not negate the results from the *in vitro* studies which do indicate the intrinsic mutagenicity of creosote/coal tar (Vaughn-Dellarco, 1983).

Comment Issue 4: Mutagenic components of creosote do not render the mixture mutagenic

The AWPI (36A) points out that while flaked coal tar pitch and components of coal tar epoxy were shown to be mutagenic in the _Escherichia coli_ WP2 reverse mutation assay, creosote/coal tar was not (Mortelmans and Ricco, 1980). It is their view to assume that the mutagenic components of a complex mixture necessarily render the mixture itself mutagenic is an invalid conclusion.

Agency Response: The Agency agrees that the mutagenicity of the individual chemical components of a complex mixture do not necessarily reflect the mutagenicity of the mixture as a whole. There may be interactions (e.g., synergisms and antagonisms) among the chemicals in the complex mixture that alter their mutagenic potential. However, this does not negate the concern with effects of the compounds individually because differential absorption of the constituents of complex mixtures may also occur. It should be emphasized that interactions between the compounds in creosote/coal tar have not been characterized in the study by Mortelmans and Ricco (1980). In addition, flaked coal tar pitch and coal tar epoxy are different complex materials and are not representative of the spectrum of chemicals and the amount of the individual chemicals present in creosote/coal tar (Vaughn-Dellarco, 1983).

Comment Issue 5: Nonspecific toxicity as the cause of unscheduled DNA synthesis

The AWPI (36A) pointed out that nonspecific toxicity may have caused the unscheduled DNA synthesis in the human fibroblast diploid cell line WI-38 (Litton Bionetics, 1978d).

Agency Response: Toxicity should not cause an increase in unscheduled DNA synthesis. In this WI-38 cell assay, toxicity would be indicated by a depression or lack of ^{3}H-Tdr incorporation. Unscheduled DNA synthesis is indicative of damage to DNA, and therefore indicative of potential mutagenicity (Vaughn-Dellarco, 1983).

3. Summary of Rebuttal and Public Comments Concerning Mutagenic Effects

The comments do not invalidate the studies of Simmon and Poole (1978) and Mitchell and Tajiri (1978) as multitest evidence for mutagenicity. The presumption of mutagenicity for creosote and coal tar/creosote, as stated in PD-1, is not rebutted.

B. Basis of Presumption and Analysis of Rebuttal and Public Comments Concerning Oncogenicity

1. Basis of Presumption

Dermal application of creosote has also been shown to produce skin tumors in mice (see Table II-1). Roe et al. (1958), for example, found that dermal application of creosote to mice also produced lung tumors. Boutwell and Bosch (1958) found that creosote had the ability to initiate tumor formation when applied for a limited period prior to treatment with the promoter croton oil. Sall and Shear (1940) showed that the number of skin tumors following dermal treatment with creosote and benzo(a)pyrene was greater than that produced by benzo(a) pyrene or creosote alone.

It has also been reported that various kinds of workers occupationally exposed to creosote developed skin tumors (Henry, 1947; Lenson, 1956; O'Donovan, 1920; Cookson, 1924).

Many studies have shown coal tar to be oncogenic in laboratory animals. For example, dermal application of coal tar produced skin tumors in mice (Horton, 1961; Shabad et al., 1971; Watson and Mellanby, 1930; Tsuitsui, 1918; Hueper and Payne, 1960; Deelman, 1962; Bonser and Manch, 1932; Gorski, 1959; Kennaway, 1925) and rabbits (Yamagiwa and Ichikawa, 1915). Exposure to coal tar via inhalation produced lung tumors in mice (Horton, 1961; MacEwen et al., 1976; Horton et al., 1963; Tye and Stemmer, 1967) and rats (MacEwen et al., 1976). Exposure of mice to coal tar aerosol also produced skin tumors (McConnell and Specht, 1973; MacEwen et al., 1976).

Dose-response relationships for the oncogenicity of coal tar have been found several times [e.g., skin tumors in mice following dermal (Horton, 1961) or inhalation (McConnell and Specht, 1973; MacEwen and Vernot, 1976) exposure]. Horton (1961) and McConnell and Specht (1973) also found a dose-response relationship for the latency period (time until diagnosis of tumors).

Skin cancer has also been reported in fishermen and others involved with the repairing and retarring of fishing nets (Shambaugh, 1935), coal tar distillery workers (Mauro, 1951), and a coal tar barrel filler (Rosmanith, 1953).

As with creosote and coal tar, dermal application of coal tar neutral oil has been shown to produce skin tumors in mice (Horton, 1961). Berenblum and Schoenthal (1947) found that several chromatographic fractions of coal tar neutral oil produced skin tumors when dermally applied to mice. Cabot et al. (1940) found that mixtures of coal tar neutral oil with benzo(a)pyrene produced fewer tumors than benzo(a)pyrene alone, but suggested that this inhibiting effect was due to skin damage.

2. Analysis of Specific Rebuttal and Public Comments Concerning Oncogenicity

The comments and respective Agency responses that follow are rebuttals submitted to the PD-1 on creosote, coal tar, and coal tar neutral oils. These rebuttals were previously published in the PD-4/3 on the wood preservative use of creosote, coal tar, and coal tar neutral oils and are included in this document for completeness. The number in parentheses after the title of each comment is an internal number assigned to each comment received. A list of the comments is in Appendix A of this document.

Rebuttal Comment 1: Reliability of Old Case Reports of Skin Cancer (2)

The AWPI asserts that the case reports of skin cancer from occupational exposure to creosote are not sufficient evidence that creosote causes skin cancer in modern wood treatment plant workers. This is because many of these exposures occurred before World War II, before "current hygienic practices and safety precautions" were in effect. Furthermore, the rebutter states that the reports are anecdotal in nature and do not contain enough details to rule out other common causes of skin cancer.

Agency Response: As with case reports in general, it is difficult to rule out entirely a role in these skin cancer cases for factors other than creosote. The Agency believes, however, that the early case reports suggest creosote has the capability of causing skin cancers. Although not providing direct evidence for a cause-effect relationship, these studies do provide supporting evidence for the Agency's concern that long-term exposure to creosote may pose a skin cancer hazard. The studies also complement the numerous laboratory animal studies showing creosote to be an oncogen (see Table II-1).

TABLE II-1

SUMMARY OF COAL TAR NEUTRAL OIL STUDIES

COAL TAR

Human Case Reports

Authors	Year	Substance and Type of Exposure	Occupation of Exposed Individual	Type of Tumor Response
Shambaugh	1935	Coal tar on repair needle held between lips	Fishermen - Net loft workers	Epidermal carcinomas of the lower lip
Mauro	1951	Handling of Coal Tar Pitch	Tar distillery workers	Cancer of skin, scrotum, cheek, and lip
Rosmanith	1953	Hot Coal Tar Vapors	Tar barrel filler	Spinocellular cancer in scar of cured erythematous lupus infection
Maugham	1980	Crude coal tar ointment applied to body below head approximately 2-3 times a day for 2-4 weeks	Persons undergoing the Goekerman treatment for psoriosis during 1950-1954	Non-melanoma skin cancers

TABLE II-1 (Continued)

COAL TAR

Animal Studies
Dermal Exposure

Authors	Year	Substance Tested	Animal & Strain	Type of Tumor Response
Yamagiwa & Ichikawa	1915	Coal tar	Rabbits (Strain Undefined)	Papillomas of the ear (site of application)
Tsuitsui	1918	Bituminous coal tar	Mice - English	Papillomas, carcinomas and spindle cell sarcoma
Kennaway	1925	Coal tar products of 450 C, 560 C, & 1,250 C distillation temperature	Mice (Strain Undefined)	Skin tumors (higher rate of carcinogenesis at higher temperatures)
Watson & Mellanby	1930	Dermal Application of coal tar following dermal application of fats, oils, or tannic acid	Mice (Strain Undefined)	Increased tumor production
		Coal tar dermal application combined with addition of butter to diet	Mice (Strain Undefined)	Higher incidence of lung nodules

TABLE II-1 (Continued)

COAL TAR

Animal Studies
Dermal Exposure

Authors	Year	Substance Tested	Animal & Strain	Type of Tumor Response
Bonser & Manch	1932	Scottish blast furnace tar; English crude tar	Mice (Strain Undefined)	Papillomas and squamous cell carcinomas of the skin
Gorski	1959	Coal tar	Mice (Bn Strain)	Skin tumors (some malignant)
Hueper & Payne	1960	Coal tar	Mice-Black (C57 Strain)	Skin carcinomas
Horton	1961	Coal tars, coal tar mixture, benzo(a) pyrene mixture	Mice (C3M Strain)	Skin tumors in 75% of each group of animals
		Coal tar distillates	Mice (C3M Strain)	Skin tumors
Deelman	1962	Coal Tar	Mice (Strain Undefined)	Skin carcinomas and papillomas
Shabad *et al.*	1971	Coal tar Ointments	Mice (C57 CBA Hybrid Strain)	Skin tumors

TABLE II-1 (Continued)

COAL TAR

Animal Studies
Inhalation Exposure

Authors	Year	Substance Tested	Animal & Strain	Type of Tumor Response
Horton	1961	Coal tar fumes preceded by inhalation of formaldehyde; coal tar fumes	Mice (C3M Strain)	Both groups developed Proliterative alveolar neoplasia; one mouse (group unspecified) developed a squamous cell carcinoma
Horton *et al*.	1963	Coal tar aerosol; Coal tar aerosol & gaseous formaldehyde	Mice (C3H Strain)	Both groups developed squamous cell tumors of lung and lung adenomas
Tye & Stemmer	1967	Coal tar; coal tar & phenolic & non-phenolic fractions of coal tar; non-phenolic fractions of coal tar	Mice (C3H/HeJ Strain)	Adenomas & carcinomas of the lung
Kinkead; McConnell & Specht; MacEwen & Vernot	1972-1974	Aerosolized coal tar - light oil & solid fraction removed	Mice (ICR-CF1) Mice (JAX-CAF1) Weanling rats (Sprague-Dawley) Yearling rats (Sprague-Dawley) Hamsters (Syrian golden) Rabbits (New Zealand white)	Mice developed skin tumors due to aerosolized material deposited on skin; Tumor response was not reported for rabbits, hamsters, or rats
MacEwen & Vernot; MacEwen *et al.*	1976	Aerosolized Coal tar	Mice (ICR-CF1) Mice (JAX-CAF1) Rats (Sprague-Dewley) Rabbits (New Zealand albino) Monkeys (Macaca Mullata)	Mice - Alveolargenic carcinoma and skin tumors; Rats - Squamous cell carcinomas; No tumor response was reported for rabbits or monkeys.

TABLE II-1 (Continued)

CREOSOTE

Human Case Reports

Authors	Year	Substance Tested	Occupation of Exposed Individual	Type of Tumor Response
Mackenzie	1896	Handling of Creosote	Worker who dipped railway ties in creosote	Warty elevation on arms; Papillmatous swellings on scrotum
O'Donovan	1920	Handling of Creosote	Workers who creosoted timbers	Skin cancer
Cookson	1924	Handling of Creosote	Creosote factory worker	Squamous epitheliomata on hand; epitheliomatous deposits in liver, lungs, kidneys and heart walls
Henry	1947	Handling of Creosote	37 men of various occupations	Cutaneous epitheliomata
Lenson	1956	Painting of Creosote	Shipyard worker	Malignant cutaneous tumors of the face

TABLE II-1 (Continued)

CREOSOTE

Animal Studies
Dermal Exposure

Authors	Year	Substance Tested	Animal & Strain	Type of Tumor Response
Sall & Shear	1940	Creosote & benzo(a) pyrene	Mice (Strain A)	Accelerated tumor formation
Woodhouse	1950	Creosote oil	Mice (Albino; Undefined Strain)	Papillomas & carcinomas
Lijinsky *et al*.	1957	#1 creosote oil	Mice - Swiss	Papillomas & carcinomas
Poel & Kammer	1957	Blended creosote oils;	Mice (C57L Strain)	Papillomas & carcinomas metastatic growths in lungs and lymph nodes
		Light creosote oil	Mice (C57L Strain)	Papillomas
Boutwell & Bosch	1958	Creosote (Carbasota)	Mice (Albino-random bred)	Papillomas & carconomas
Roe *et al*.	1958	Creosote oil (Carbasota)	Mice (Strain Undefined)	Skin & lung tumors

TABLE II-1 (Continued)

COAL TAR NEUTRAL OIL

TABLE II-1 (Continued)

CREOSOTE

Animal Studies
Dermal Exposure

Authors	Year	Substance Tested	Animal & Strain	Type of Tumor Response
Cabot *et al*.	1940	Benzene Solution of neutral oil & benzo(a) pyrene	Mice - albino "market" mice	Inhibitory effect of tumor response as compared to tumor response with benzo (a)pyrene (effect credited to skin damage)
Berenblum & Schoental	1947	5 Coal tar neutral oil fractions	Mice (Strain Undefined)	All fractions but two were oncogenic
			Rabbits (Strains Undefined)	All fractions but one were oncogenic
Horton	1961	Coal tar neutral oils (maleic anhydride extracts)	Mice (Strain Undefined)	Produced tumors in 34.1 and 32.1 weeks

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The rebutters present neither firm evidence that the current formulations of creosote are safer than the formulations used before World War II nor evidence as to the extent or effectiveness of "current hygienic practices and safety precautions."

Rebuttal Comment 2: Small Number of U.S. Case Reports (149)

Allied Chemical Corporation questioned the skin cancer hazard from creosote manufactured and used in the United States. The rebutter points out that, of the mere eight reports of skin cancer among exposed workers cited in PD-1, only two were from the United States. One of these reports concerns an individual who was a painter for 41 years prior to a 3-year job working with creosote. The other report deals with a fisherman working with tarred nets. The rebutter states that exposures to paint solvents could have caused the face cancer of the painter, and that exposure to tarred fishing nets is not relevant to the use of creosote as a wood preservative. The rebutter recognizes, however, that most experts agree that long-term dermal exposures to high levels of creosote poses a possible skin cancer hazard. The rebutter presented a new survey of Allied plant workers documenting skin lesions that these workers had incurred. The dermatologists questioned in the survey concluded that proper personal hygiene and periodic medical surveillance would prevent serious skin diseases.

Agency Response: Although the rebutter provides no evidence showing that paint solvents may have contributed to the cause of the painter's cancer, the Agency acknowledges the possibility that such may have been the case. Similarly, although the rebutter has submitted no data, the tar used for the fishing nets may indeed be qualitatively different from that used for wood preservation.

Still, the basis for the Agency's concern is not limited to the eight human case reports cited in PD-1, but also includes the 21 animal studies on coal tar and creosote (see Table II-1). The Agency agrees with the rebutter that creosote exposure, if continued for a long duration at high levels, constitutes a skin cancer hazard.

Rebuttal Comment 3: Reliability of Henry, 1947 (143)

West European Tar Industries criticizes the case report study of Henry (1947) which reviewed 3,753 cases of cutaneous epitheliomata. The rebutter points out that the National Institute for Occupational Safety and Health (NIOSH) discounted this paper because Henry "did not describe the bases for his conclusions."

Agency Response: The Agency agrees with NIOSH and the rebutters that the lack of certain information in Henry's report, such as the number of workers exposed to creosote, makes it difficult to quantify the relationship between exposure and cutaneous cancer. However, Henry's paper does provide strong evidence that the site of cutaneous cancer was associated with the nature of a worker's occupation, thereby supporting the occupational basis of these cancers.

Rebuttal Comment 4: Health Records of Creosote-Exposed Workers (151, 193)

The Association of American Railroads submitted a summary of a 4-year study which reported 971 dermatitis or burn cases caused by creosote in railroad workers. The rebutter also summarized the health records of about 90 workers in two railroad tie treating plants. These records cover a period of about 30 years. The rebutter believes that, although workers exposed to creosote may develop "initiative dermatitis" or "transient eye involvement," the studies provide no evidence of an increased incidence of creosote-related skin cancer.

In another rebuttal comment, Samuel Cabot, Inc. states that, following a review of that company's employee files, no "report of any critical or permanent illness linked to employee exposure to creosote" was found.

Agency Response: The summary reports submitted by the rebutters do not indicate that the studies were specifically designed to detect an increased incidence of skin cancer. For example, they do not provide mortality, morbidity, or exposure data.

Also, it appears that the studies consist of an examination of voluntary reports of individual's medical complaints rather than systematic surveillance of skin diseases possibly related to creosote exposure. Therefore, the information provided by the rebutters is not definitive evidence that creosote is not associated with induction of skin cancer.

Rebuttal Comment 5: New Epidemiology Studies (1)

Koppers Company submitted three studies in support of their conclusion that workers exposed to creosote are not subject to an excess risk of cancer. Two of the studies are epidemiological (proportional mortality), and the third is a summary of worker's health examinations.

Agency Response: The Agency does not believe these studies either support or refute the rebutter's conclusion. The studies are deficient because in each one a biasing factor exists due to the method of selection of deaths. For example, it appears that individuals who spent a period of years working for Koppers and then left for other employment prior to retirement were not counted. The Agency assumes that the data included only individuals who died while employed by Koppers or after retirement from Koppers. Individuals who left the company because of illness, and later died from such illness, may not have been included in the data. The Agency concludes that, as these studies did not have the proper controls that should be present in good epidemiological investigations, the studies are incomplete and inconclusive.

The third study is merely a summary of healthy workers' health examinations. Much follow-up work is required before this information can be of use in detecting serious diseases.

Rebuttal Comment 6: Metabolism of Creosote Components (149)

Allied Chemical Corporation states that the polycyclic aromatic hydrocarbons (PAH's) contained in creosote are metabolized and excreted in mammals, implying that these biological functions automatically reduce or eliminate the oncogenicity of these compounds.

Agency Response: While it is true that mammals do metabolize both oncogenic and nononcogenic PAH's, it is not true that all the metabolites of these compounds are innocuous. Some PAH's are metabolized to active oncogens regardless of the route of administration or dose level (Dipple, 1976). Also, it remains possible that some oncogenic PAH's exert their biological influence before they can be metabolized completely. Thus, PAH's may pose an oncogenic risk to exposed humans.

Rebuttal Comment 7: "Anticarcinogenic" Activity of Creosote Components (2)

The AWPI states that creosote solutions contain "anticarcinogenic" substances as well as suspected oncogens. The rebutter suggests that the consequence of this may be that the potential for any oncogenicity, due to the presence of "well-established carcinogens," is cancelled out.

Agency Response: The Agency is not aware of any evidence that the presence of "anticarcinogenic" substances in creosote solutions counteracts the oncogenic components. Although creosote may contain some inhibitory compounds, it also clearly contains both carcinogenic initiators and promoters, as well as complete carcinogens. Also, numerous laboratory animal studies cited in PD-1 adequately demonstrate that whole creosote is oncogenic (see Table II-1).

Rebuttal Comment 8: Dermal Application of Coal Tar Medicinals (191)

The Joint Industry Coal Tar Committee cited the testimony of P.E. Weary and E.M. Farber before the Food and Drug Administration's Antimicrobial Panel II (DHEW, 1977) as evidence that even coal tar medicinals, which are applied directly to the skin, do not cause skin cancer. Dr. Weary concluded (page 11 of the DHEW document) that in his 21 years of dermatologic practice, he had found no solid evidence that coal tar products cause skin cancer. Dr. Farber sent questionnaires to 91 physicians who had been using these products for at least 30 years. Again, there was no indication that these products caused any skin cancers (page 300 of the DHEW document).

Agency Response: Although testimony of this type is informative, these comments do not rebut the oncogenicity presumption for creosote. In the same symposium transcript (pp. 181-4) it was concluded that coal tar medicinals contain at least four agents that cause tumors in laboratory animals: benzo(a)pyrene, beta-naphthalamine, o-toluidine, and quinoline. Also, Dr. Hoffman points out (page 184) that a review of the literature in 1966 (Greither et al., 1966) revealed that "thirteen cases of skin cancer were reported in patients who used coal tar preparations. Of these cases two were also treated with arsenicals."

In conclusion, the Agency is unaware of any adequate long-term studies to characterize the oncogenic effects of the use of coal tar medicinals in the induction of skin cancer.

Rebuttal Comment 9: Reliability of Mouse Skin-Painting Studies (193)

Samuel Cabot, Inc. attacks the utility of mouse skin-painting studies as a reliable basis of establishing the oncogenicity of creosote. In the opinion of this rebutter, the studies lack adequate controls, detailed information on dose levels, route of administration, sex, strain and species of test animals, and experimental design. Weisburger (1975) is cited in support of invalidation of these earlier studies.

Agency Response: The Agency agrees that two of the six studies had no controls. Nevertheless, the consistent positive response in these studies cannot be ignored. Older studies cannot automatically be invalidated due to lack of conformity to present-day protocols. Also, Dr. Weisburger's article

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merely listed several variables which affect the carcinogenic response in animal experiments. The mere listing of these variables does not invalidate these specific studies.

Rebuttal Comment 10: Reliability of Horton *et al.*, 1963 (149)

Allied Chemical Corporation suggests that the positive oncogenic response found by Horton *et al.* (1963) with coal tar aerosols may have been due to aggravation by the formaldehyde carrier.

Agency Response: The positive oncogenic response in the mouse study with coal tar aerosols is not explained by the effect of formaldehyde because the group treated with coal tar alone gave a greater response than the group treated with coal tar plus formaldehyde.

Rebuttal Comment 11: Inappropriateness of Rodents as Models for Oncogenicity (2)

The AWPI questioned the reliability of rodent species as models for oncogenicity in man. The rebutter states that these species are inappropriate due to major differences in the metabolic, pharmacokinetic, and biochemical characteristics of rodents and man.

Agency Response: The Agency finds no merit in the rebutter's comment. It is accepted Agency policy to rely on the results of animal studies to demonstrate the oncogenic potential of a chemical agent. This policy, as stated in the Interim Cancer Guidelines (FR 41:21402-21405, May 25, 1976), is that "a substance will be considered a presumptive cancer risk when it causes a statistically significant excess incidence of benign or malignant tumors in humans or animals."

The scientific rationale for using animal studies for this purpose is multifaceted. First, very few industrial chemicals and processes have been subjected to adequate epidemiological studies to determine whether or not they cause carcinogenic effects in workers. Second, epidemiological studies are insensitive and little weight can be placed on surveys which do not show positive results. Third, many industrial chemicals have not been in production long enough for any effects to be observable, bearing in mind the long latent periods for chemically-induced cancers. Fourth, it would be unethical to wait for evidence of harm in exposed workers when risks can be established relatively quickly by animal experimentation.

A risk assessment which relies solely on animal data would be less reliable for humans in a situation where definite metabolic pathway differences can be shown between animals and humans. Since the rebutter presented no clear-cut evidence of such differences for the metabolism of creosote, there is no basis for qualifying the risk assessment on metabolic grounds.

Rebutttal Comment 12: Lack of Oncogenic Response to Benzo(a)pyrene (193)

Samuel Cabot, Inc. cites Dr. Weisburger (1975), pointing out that after 8 to 10 years of skin applications to primates of some known oncogens, including benzo(a)pyrene, no tumors were observed. The rebutter submits this as evidence that creosote is not oncogenic.

Agency Response: The major purpose of this section of Dr. Weisburger's article was to show the inter-species variation in response to oncogens, and not to demonstrate that benzo(a)pyrene is nononcogenic. Moreover, on page 279 (Table 8.4) of her article, Dr. Weisburger lists both coal tar and creosote as human oncogens.

The following comments were submitted to the Agency in response to the Position Document 2/3 on the wood preserving uses of creosote, inorganic arsenicals, and pentachlorophenol.

Comment Issue 1: Lip cancer in fishermen

The AWPI (36A) questions Shambaugh (1935), which reports on fishermen who held tar-soaked needles in their mouths and developed lip cancer, as evidence of the carcinogenicity of creosote/coal tar. The AWPI (36A) cites Spitzer et al. (1975) as evidence that holding a tar-soaked needle in one's mouth does not increase the risk of lip cancer.

Agency Response: The Agency has reviewed the Spitzer et al. study (1975), and concludes that the absence of definitive exposure data precludes the use of the Spitzer study to refute the Shambaugh (1935) study. For example, it is unclear as to whether the fishermen in the Spitzer study placed needles moist with coal tar and/or coal tar-soaked nets in their mouths. Also, the type of "tar" used in Spitzer's study is not defined. It seems likely that pine tar or some less toxic tar would have replaced coal tar used as a preservative in Shambaugh's (1935) study by the time of Spitzer's study (CAG, 1982).

Comment Issue 2: Coal tar distillates and cancer

The AWPI (36A) cites "Of Mice and Men and Coal-Tar Distillates: A Rebuttal of Popular Presumptions and Dogmas on Cancer Causation" (Poel, 1980) as evidence that there is no increased incidence of skin or respiratory cancer associated with occupational exposure to coal tar distillates.

Agency Response: Poel (1980) cited mortality studies by Lloyd (1971), Redmond (1976) and Redmond et al. (1979) as epidemiological evidence that worker exposure to coal tar or coal tar distillates was not associated with cancer of the scrotum, skin, or lung; studies by Reid and Buck (1956) as evidence that there was no increased mortality to coking plant employees from lung cancer; and studies by Doll et al. (1956, 1972) which concluded that men exposed to coal carbonization by-products did not experience excess mortality risk from cancer of the lung, bladder, skin, scrotum or other sites.

The Agency has carefully reviewed the studies cited above and finds that there are deficiencies in each study which preclude the Agency's concurrence with the author's conclusions. The mortality studies conducted by Lloyd (1971), Redmond (1976), and Redmond et al. (1979) may not demonstrate excess risk of skin cancer from coal tar distillates because of the low case-fatality rate of skin cancer. With regard to lung cancer mortality, almost a twofold increase in deaths would be required to detect a statistically significant difference between the observed and the expected, given the expected number of lung cancer deaths among by-product workers. In neither the Lloyd (1971) nor the Redmond et al. (1979) studies was there a control for smoking, the most important confounder for lung cancer in any occupational study (CAG, 1982).

Reid and Buck (1956) failed to adequately define the basic study population. In studying the causes of death during 1949-1954, it is unclear if the study population includes all dying men who were "on the books" in a coke plant during 1949-1954, or only those found through a special 1952 census. If the cohort consisted of workers currently employed in 1952, and because there was little or no follow up of any of these members, it appears that this study is basically a cross-sectional study of mortality in a conglomerate of several different coke plants. The observed deaths appear to have occurred to members of the study group employed during 1949-1954. Therefore, the number of cancer deaths observed may have been deficient since it was reported by Lloyd (1971) that men were removed from the books after prolonged absence from work. Because there were no follow-ups after 1954, latent effects were not adequately considered. It is not known how the death rates used to calculate expected deaths were derived or defined; therefore, it is not clear if they are compatible with the definition the authors used to derive the study population (CAG, 1982).

With regard to the Doll et al. study, the likelihood of detecting a statistically significant elevation in lung cancer deaths given the number of expected lung cancer deaths (number = 2.14) in the study population of by-product workers is less than 0.8 even if the number of lung cancer cases had been elevated 3.5 fold (assuming a Poisson distribution). The likelihood of detecting a statistically significant excess of mortality from bladder, skin, scrotum, and other sites is even less. Skin cancer mortality is a poor indicator of the skin cancer risk from exposure to coal tar distillate products because the case-fatality rate is so low. Finally, there was no control for smoking (CAG, 1982).

Comment Issue #3: Dermal oncogenic potential of creosote and coal tar

The AWPI (36A) claims that the Agency relied primarily on animal studies to evaluate the dermal oncogenic potential of creosote and coal tar because of the unavailability of adequate epidemiological studies. They pointed out that Maugham et al. (1980) completed a long-term follow-up study of persons treated with coal tar medicinals for psoriasis (the Goekerman Treatment) which demonstrates no increased incidence of non-melanoma skin cancer in these patients.

Agency Response: The Agency has based its qualitative conclusion that creosote is an oncogen on both animal studies and human case studies. The EPA rejects AWPI's position that creosote is not an oncogen based on the Maugham et al. (1980) study to evaluate the dermal oncogenic potential of creosote and coal tar because of methodological deficiencies and because the short duration of the Joekerman treatment (2-4 weeks) is not comparable to an occupational exposure to creosote/coal tar, (e.g. wood treaters).

The Maughman et al. (1980) study population consisted of persons who had undergone the Goekerman treatment for psoriasis, in which 2%-5% crude coal tar ointment was applied to body areas generally below the head, approximately 2-3 times a day, for 2-4 weeks. In 1979, the authors contacted 305 of the 426 persons (72%) identified as receiving the treatment during the years 1950-1954. The loss of 28% of the study population could have skewed the study results. The Goekerman treatment patients ranged in age from one year to late adulthood, therefore, the recall of information would not be expected to produce very reliable data (CAG, 1982).

The incidence rates used to calculate the expected number of skin cancer cases were derived from medical record abstractions and from 1970 census data for four geographic areas of the United States. Comparing incidence rates derived by abstracting medical records to rates derived by survey methods through questionaires may be a problem due to potential underreporting by those surveyed. In analyzing the data, Maughman et al. (1980) compared the number of non-melanoma skin cancers among persons who had undergone the Goekerman treatment with the number that would have been expected had the patients lived in four different geographic areas of the United States. This resulted in an incidence of cancer among the study group which was higher than expected for three of the four comparison areas. The authors concluded, however, "that because the study group was a varied group geographically, there would seem to be no significant increase from the reported incidence figures." However, the Agency cannot concur with the author's conclusions because there was no adjustment for geographic areas and because the observed number of cases exceeded the expected rates derived from three of the four geographic areas (CAG, 1982).

Comment Issue 4: Skin carcinoma due to creosote/coal tar exposure

The AWPI (36A) cites a study dealing with industrial disease benefits (Lederer and Phillips, unpublished) as evidence that creosote/coal tar exposure does not lead to an excess incidence of skin carcinoma among workers exposed to coal tar and coal tar products.

Agency Response: The Agency has reviewed the Lederer and Phillips (unpublished) report which is a comparison of the incidence of squamous cell carcinoma among United Kingdom workers in "coal tar related industries" to the incidence of squamous cell carcinoma in England and Wales. The Agency finds that it cannot agree with the report's analysis because of invalid statistical methodology concerning incidence rates. By definition, for a disease incidence rate, those people qualifying as the population must also qualify as potentials for the actual cases. However, in this study, the squamous cell carcinoma cases were identified for the year 1973, the worker population represented the year 1977, and the incidence rate included industrial classifications which apparently differed with the employment categories used to derive the prescribed disease data.

A comparison of incidence rates for United Kingdom (Ireland, Scotland, Wales and England) workers in coal tar-related industries to population incidence rates for England and Wales may be biased if the incidence of skin cancer in England and Wales is substantially different from the United Kingdom. Comparison of incidence rates among any working population with population rates may also be a biased comparison because of the "healthy worker effect." For example, persons who develop skin cancer or precancerous lesions from working with coal tar materials may change occupations or drop out of the working population altogether. Also, the comparison of a squamous cell carcinoma crude incidence rate for the coal tar-related industrial workers and for the general population is biased because the age distribution of a working population is considerably different from that of the general population (CAG, 1982).

Finally, the comparison of incidence data derived from disease benefit awards with incidence data for the population is also a biased comparison because the disease benefit award is a selective process and population incidence data are not selective (CAG, 1982). Therefore, no conclusions can be drawn from the Lederer and Phillips (unpublished) study about the incidences of skin carcinoma among workers exposed to coal tar products.

Comment Issue #5: Increased risk of skin, bladder or lung cancer due to creosote exposure at wood treatment plants

The AWPI (36A) cites Flickinger's (1980) conclusion that creosote exposure at wood treatment plants did not increase the risk of skin, bladder, or lung cancer. Flickinger based his conclusion on the Tabershaw Occupational Medicine Associates (1980) health study of wood treatment plant workers.

Agency Response: This industrial hygiene report (Flickinger, 1980) provides some indication as to the amount of benzene-soluble material and different polycylic constituents of creosote and coal tar to which wood treaters are exposed. However, the report provides no indication of the carcinogenic risk that such exposure may present (CAG, 1982).

The Agency carefully reviewed the Tabershaw Occupational Medicine Associates (1980) cross-sectional health examination survey of workers at five work treatment plants and cannot agree with the conclusion because of several analytical problems.

The population examined (329) is not large enough to assess the effect of creosote exposure on cancer prevalence. If the U.S. prevalence rates for skin cancer (National Center for Health Statistics or NCHS) used by the authors for comparison were used to calculate the expected number of cases, it would have required as much as a 2.9-fold increase over the expected in order to detect a $P < 0.05$ difference (statistical power = 80% probability) (CAG, 1982).

Blacks experience very little skin cancer, and blacks comprised 46.5% of the total plant population. Therefore, the comparison of a skin cancer rate from the NCHS prevalence statistics to the observed skin cancer rate in the study population would be a biased comparison that would underestimate a skin cancer risk if it was present (CAG, 1982).

Although a cross-sectionally-designed study will assess current problems at the treatment plants, workers who have skin cancer may have left the plants. The study population did indicate significant ($P < 0.05$) increases in benign growths, a condition which sometimes is a precancerous lesion. There was also a significant elevation of pseudofolliculitis in the study population. These eruptions were located in areas where clothing rubbed against the skin rather than in sun-exposed areas, which suggests that this effect is a result of the preservative and that workers are being exposed to creosote though their clothing (CAG, 1982).

Cancer latency, or the time from carcinogen exposure to cancer development, may be as long as 25 years. Seventy percent of those examined in the Tabershaw study had worked 10 years or less in the treatment plants. Only 13% of the study population had between 10 and 15 years of exposure while 6% of those in the study group had worked between 15 and 20 years in the plants. The majority of the workers that were examined by Tabershaw Occupational Medicine Associates had not been at the treatment plants long enough, if skin or other types of cancer were to develop from creosote exposure (CAG, 1982).

There is no indication in this study whether those that were examined were actually exposed to creosote and coal tar. It is expected that some of those examined were office workers and would have had little contact with the preservative. The inclusion of such persons in the study population would have reduced the prevalence rates of skin cancer or precancerous lesions if creosote and coal tar were increasing the risk of skin cancer among treatment workers (CAG, 1982).

Comment Issue 6: Creosote and lung cancer among roofers

The AWPI (36A) states that the excess lung cancer mortality among roofers in the Hammond et al. (1976) study is probably attributable to smoking rather than to exposure to coal tar and asphalt. The AWPI (36A) also suggests that because only five skin cancer deaths were recorded among the 5,939 roofing workers, the incidence of skin cancer among the roofers and the general population is no different.

Agency Response: The Agency finds merit in AWPI's (36A) comment on the lung cancer incidence rate but does not concur with the comments regarding skin cancer. The Agency concludes that some of the excess lung cancer deaths among the roofers in the Hammond et al. (1976) study may have been attributable to smoking. And, this excess may be enough to make the association found by Hammond of occupational exposure of roofers with lung cancer mortality, statistically not significant. However, because the sample size of roofers is relatively small, the results of the Hammond et al. study with regard to lung cancer mortality must be considered inconclusive (CAG, 1982).

However, the Hammond study of roofers was a mortality study, not an incidence study. Incidence is the number of new cases of a disease in a given population over a specified time period, usually one year. Skin cancer mortality may be a poor reflection of incidence because the case-fatlity rate for skin cancer is so low (CAG, 1982).

Also, the number of skin cancer deaths among roofers was more than expected, which is contrary to what the AWPI (36A) has implied. Among roofers who belonged to the union for 9-19 and 20 or more years the mortality ratios for skin cancer were 4.65 and 4.00, respectively. These ratios are based on small numbers, however, and are not statistically significant (CAG, 1982).

Comment Issue 7: Creosote animal oncogen studies

The AWPI (36A) states that the EPA persists in maintaining in the PD-2/3 that creosote and many component chemicals have been well characterized as carcinogens in laboratory animal studies (PD-2/3, p.85, EPA, 1981,). The AWPI (36A) reiterates its PD-1 rebuttal criticism of EPA's animal oncogen studies and maintains that these studies are indeterminate, inapplicable to humans and irrelevant in light of overwhelming modern epidemiological evidence.

Agency Response: As stated in the PD-1, the animal studies presented show tumor production following dermal and inhalation exposure to coal tar (Fed. Register, 43 FR 48154, Oct. 1978). The Agency has also presented in the PD-2/3 (EPA, 1981) numerous laboratory animal studies which demonstrate an unequivocal correlation between creosote exposure and animal carcinogenesis. The Agency has cited various human case reports implicating creosote as a human carcinogen. Moreover, various chemical components of creosote such as benzo(a)pyrene, benzo(a)athracene, quinoline, and many others are known carcinogens (EPA, 1981). These data provide an overwhelming qualitative assessment of inherent hazard associated with creosote exposures.

For an analysis of the creosote epidemiological studies see Comment Issues #1 through #6.

3. Summary of Rebuttal and Public Comments Concerning Oncogenic Effects

The comments submitted have presented no substantial information which shows that creosote does not pose and oncogenic risk to humans.

Data from animal experiments show that creosote induces squamous-cell carcinomas and papillomas of the skin and adenomas and carcinomas of the lung. These positive results in laboratory animals are supported by the numerous case reports of skin cancer in people heavily exposed to creosote. Thus, the original conclusions presented in PD-1 are still valid, and the presumption of oncogenicity for creosote, coal tar, coal tar neutral oils is not rebutted.

C. Analysis of Rebuttal Comments Concerning Human Exposure

Comments on the exposure assessment presented in the PD-1 on creosote, coal tar, and coal tar neutral oils all pertained to the use of these chemicals as wood preservatives. No comments concerning exposure as a result of the non-wood preservative uses of these chemicals were submitted to the Agency.

D. Human Exposure Analysis

1. Chemistry

Coal tar and neutral oils is an extremely complex mixture produced by coking, the high temperature carbonization of coal. Creosote is a lower boiling distillate of coal tar. Both mixtures vary in composition depending on the temperature of coking and the source of coal use (PD-2/3). Each chemical entity has its own chemical characteristics such as solubility, vapor pressure, viscosity, etc. Furthermore, each creosote batch is often produced from different source materials leading to a different chemical composition.

In distilling coal tar to form creosote, the lower molecular weight compounds are concentrated. The balance of polynuclear aromatic hydrocarbons (PAH's) in creosote contain one to four rings, although larger PAH's such as benzo[a]pyrene, benzo[j]fluoranthane, and benzanthracene have been positively identified (PD-2/3). Lorenz and Gjovik (1972) have identified the major constituents in creosote. Eighteen compounds, accounting for about 75-85% of the total volatile creosote material, were identified and are listed in Table II-2. Table II-3 presents a listing of all of the compounds found in creosote. There is variation in the relative percentage of individual components in different creosote samples. Creosote also contains smaller amounts of phenolic constituents as well as nitrogen-, oxygen-, and sulfr-containing heterocyclic ring systems and aromatic amines.

Therefore, because of the variable nature of creosote, coal tar, and coal tar neutral oil to which humans are exposed, it is not possible to compute quantitative exposure estimates. The exposure assessment will rate exposure potential to the various non-wood uses qualitatively with respect to the degree of exposure. The rating of exposure potential is based on available information regarding the application methods.

TABLE II-2

Major Components of Creosote [a]

Component	Approximate Percentage	Boiling Point (°C)
Naphthalene	3.0	218
2-Methylnaphthalene	1.2	241.05
1-Methylnaphthalene	0.9	244.64
Biphenyl	0.8	255.9
Dimethylnaphthalenes	2.0	268
Acenaphthene	9.0	279
Dibenzofuran	5.0	287
Fluorene	10.0	293-295
Methylfluorenes	3.0	318
Phenanthrene	21.0	340
Anthracene	2.0	340
Carbazole	2.0	355
Methylphenanthrenes	3.0	354-355
Methylanthracenes	4.0	360
Fluoranthene	10.0	382
Pyrene	8.5	393
Benxofluorenes	2.0	413
Chrysene	3.0	448

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[a] Adapted from Lorenz and Gjovik (1972).

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TABLE II-3

Compounds Present in Creosote

Coumarone
1,2,3-Trimethylbenzene
Hydrindene
Phenol
Indane
Aniline
3,4-Dimethylethylbenzene
Ammonium thiocyanate
6-Methylcoumarone
0-Cresol
Benzonitrile
3 or 5-Methylcoumarone
n-Undecane
Durene (1,2,4,5-tetramethylbenzene)
4-Methylcoumarone
Isodurene (1,2,3,5-tetramethylbenzene)
p-Toluidine
o-Toluidine
p-Cresol
Acetophenone
m-Cresol
m-Toluidine
4-Methylindene
Tetrahydronaphthalene
2,4-Xylenol
2,6-Xylenol
2,5-Xylenol
2,4-Xylidine
m-Ethylphenol
2,5-Xylidine
p-Ethylphenol
Naphthaline
2,3-Xylenol
3,5-Xylenol
3,5-Xylidine
3,6-Dimethylcoumarone
4,5-Dimethylcoumarone
4,6-Dimethylcoumarone
Thionaphthene
2,3-Xylidine
3,4-Xylenol
Dimethylindane
Pseudocumenol (2,4,5-trimethylphenol)
3-Ethyl-5-methylphenol
2,3,4,5-Tetramethylpyridine
Isopseudocumenol (2,3,5-trimethylphenol)
Quinoline (leucoline)
7-Hydroxycoumarone
Methylthionaphthalene
Isoquinoline
4-Hydroxyhydrindone
1-Methylnaphthalene
2-Methylquinoline
2,8-Dimethylquinoline
7-Methylquinoline
6-Methylquinoline
3-Methylquinoline
2,6-Dimethylnaphthalene
2,7-Dimethylnaphthalene
1,7-Dimethylnaphthalene
1,3-Dimethylisoquinolene
1,6-Dimethylnaphthalene
5-Methylquinoline
4-Methylquinoline
5- or 7- Methylisoquinoline
3-Methylindole (skatole)
1,5-Dimethylnaphthalene
6-Methylisoquinoline (probable)
7-Methylindole
2,3-Dimethylnaphthalene
1,2-Dimethylnaphthalene
4-Methylindole
5-Methylindole
3-Methyldiphenyl
5,8-Dimethylquinoline
4-Methyldiphenyl
2-Methylindole
o-Phenylphenol
1,3,7-Trimethylnaphthalene
a-Naphthol
Acenaphthene
a-Naphthofurane
B-Naphthofurane
2,3,5-Trimethylnaphthalene
2,3,6-Trimethylnaphthalene
B-Naphthol
Diphenylene oxide
2,4,6-Trimethylquinoline
3,4'-Dimethyldiphenyl
4,4'-Dimethyldiphenyl
g-Diphenylenemethane
4,5-Benzindan
1-Naphthonitrile (1-cyanonaphthalene)
1-Methyldiphenylene oxide
Fluorene
Hydroacridine
1-Naphthylamine
2-Methyldiphenylene oxide
2-Naphthonitrile (2-cyanonaphthalene
Paraffin (octadecane)
Heneicosane

TABLE II-3 (Continued)

2-Methylfluorene
3-Methylfluorene
p-Phenylphenol
Tricosane
Tetracosane
Pentacosane
Docosane
Nonadecane
Hexacosane
Heptacosane
Octacosane
Diphenylene sulfide
Phenanthrene
Tetramethylbiphenol
Anthracene
Acridine
2-Hydroxybiphenylene oxide
Phenanthridine
3-Methylphenanthrene
Carbazole
2-Hydroxyfluorene
4,5-Phenanthrylenemethane
9-Methylphenanthrene
1-Methylphenanthrene
2-Phenylnaphthalene
Hydroxyanthracene
Naphthacene
2-Methylanthracene
2,7-Dimethylanthracene
2-Methylcarbazole
1,2,3,4-Tetrahydrofluoranthene
Truxene
3-Methylcarbazole
Fluoranthene
2,3,5,6-Dibenzocoumarone
Pyrene
1,9-Benzoxanthene
2-Hydroxyphenanthrene
(2-phenanthrol)
Retene (8-methyl-2-isopropylphenanthrene)
1,2-Benzofluorene (naphthofluorene)
2,3-Benzofluorene (isonaphthofluorene)
Naphtho-2',3',2-anthracene
1,2-Benzonaphthacene
Phenanthridone
Dibenzothionaphthalene
Sulfur
Chrysene
Triphenylene

Acenaphthalene
Dibenzofuran
9,10-dihydroanthracene
2-Phenylnaphthalene
9,10-Benzophenanthrene

The chemicals comprising creosote have been characterized by McNeil (1952) into eight classes. These classes are presented in the risk assessment section because they are of interest toxicologically (Table II-6). Chemicals derived from coal mined from different sources can vary in the relative proportions of chemicals present. However, McNeil emphasizes that all creosotes contain essentially the same classes of chemical compounds, even while the proportion and distribution of classes varies.

Coal tar and coal tar neutral oils are often blended with creosote for the uses under consideration in this document. Coal tar comprises the entire spectrum of non-aqeuous coke oven volatiles. Because the condensate extends to boiling regions higher than those of the creosote fractions, coal tar contains a large number of 5- and 6-ring polynuclear aromatic hydrocarbons.

The Agency has prepared estimates of dermal and respiratory exposure for the non-wood preservative uses of creosote, coal tar, and coal tar neutral oil. Table II-4 presents information regarding the application practices use-by-use. Table II-5 is a summary of the Agency's qualitative exposure analysis of creosote, coal tar, and coal tar neutral oil.

TABLE II-4

Summary of Application Practices By Use for Non-Wood Uses of Creosote, Coal Tar, and Coal Tar Neutral Oils

USE	PESTICIDAL ACTION	MODE OF APPICATION
HERBICIDAL		
1. Ornamental flowering plants and ornamental lawns	Nutgrass control	Spot treatment
2. Product Storage Yards	Weed and grass control	No information
3. Agricultural Premises (fencerows) and Highway Rights-of-Way	General weed control	Broadcast spray or spot treatment
FUNGICIDAL		
Rope and Canvas	Prevent algae and fungi	Brushed; sprayed; Manually dipped, (ropes only)
BIOCIDAL		
1. Seed Potato Storage Premises and Equipment	Bacterial control - ringrot	Sprayed; dip tub.
2. Livestock Premises	Bacterial control - ringrot	Sprayed; wipe; mop.
3. Poultry Premises	Bacterial control	Sprayed; wipe; mop.
4. Home/Institutional Use (toilets; washrooms; water closets; garbage cans; sinks)	Bacterial control	Sprayed; wipe; mop.

TABLE II-4

Summary of Application Practices By Use for
Non-Wood Uses of Creosote, Coal Tar, and Coal Tar Neutral Oils

USE	PESTICIDAL ACTION	MODE OF APPICATION
5. Livestock Transport Vehicles	Bacteria/virus control	Presumed to be sprayed or mopped
6. Tree Wound Dressings	Bacterial/fungal control	Brushed
7. Metalworking Fluids (Cutting Oils)	Bacterial/fungal control	Metering pump or manually
INSECTICIDE, MITICIDE, LARVICIDE, REPELLENT		
1. Mosquitoes	Larvicide	Sprayed onto water surface to control mosquito and fly larva by covering water with a surface film; not used for many years
2. Repellent	Animal	Brushed/sprayed on stalls to prevent cribbing by horses
	Bird	Applied to seed corn
	Insect	Hand application
3. Horses/Mules	Screwworm control	Not in use

TABLE II-4

Summary of Application Practices By Use for Non-Wood Uses of Creosote, Coal Tar, and Coal Tar Neutral Oils

USE	PESTICIDAL ACTION	MODE OF APPICATION
4. Insect control		
- Drain flies	Aids in control of flies; (Orthodichlorobenzene is the active ingredient in these products that is the insecticidal agent)	Poured into drains
- Garbage Trucks		Sprayed
5. Gypsy Moth Control	Controls gypsy moth egg masses	Brush
6. Animal Dip (Non-food Animals)	Mites	Dip, wash, or swab

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TABLE II-5

Summary of Exposure Analysis - Non-Wood Uses of Creosote, Coal Tar, and Coal Tar Neutral Oils

USE	ASSUMPTIONS USED IN ANALYSIS	EXPOSURE POTENTIAL	
		Dermal	Inhalation
HERBICIDAL			
1. Ornamental flowering plants and ornamental lawns	a. 10% A.I. concentration used b. Spot treatment - sprayed c. Applied as needed d. Product concentration is low and minimal exposure is expected	low	low
2. Product Storage Yards	a. 75% A.I. concentration b. Sprayed c. Estimated application frequency: twice/year	medium	medium
3. Aricultural Premises (fencerows) and Highway Rights-of-Way	a. 75% A.I. concentration b. Sprayed c. Estimated application frequency: twice/year	medium	medium
FUNGICIDAL			
Rope and Canvas	a. 97% A.I. concentration b. For ropes and canvas, product is brushed and sprayed; ropes are sometimes dipped into product. c. Application to 1 product is considered for estimating exposure; many products are treated per day; 8 hour/day exposure is assumed.	medium(brush) high(spray) high(dip)	medium (brush) high(spray) high(dip)

TABLE II-5

Summary of Exposure Analysis -
Non-Wood Uses of Creosote, Coal Tar, and Coal Tar Neutral Oils

USE	ASSUMPTIONS USED IN ANALYSIS	EXPOSURE POTENTIAL	
		Dermal	Inhalation
BIOCIDAL			
1. Seed Potato Storage Premises and Equipment	a. 1-2% A.I. concentration b. Sprayed c. Each worker applies product for one day or less d. Estimated application frequency: 1-5 times/year e. Because the use concentration is less than 2%, exposure of these uses is considered low; however, inhalation exposure can be critical because application is generally in enclosed areas. f. Potential dietary exposure	low	medium
2. Livestock Premises	a. 1-2% A.I. concentration b. Sprayed, wipe, mop c. Estimated application frequency: 12-16 days/year d. Because the use concentration is less than 2%, exposure of these uses is considered low; however, inhalation exposure can be critical because application is generally in enclosed areas.	low	medium

TABLE II-5

Summary of Exposure Analysis -
Non-Wood Uses of Creosote, Coal Tar, and Coal Tar Neutral Oils

USE	ASSUMPTIONS USED IN ANALYSIS	EXPOSURE POTENTIAL	
		Dermal	Inhalation
3. Poultry Premises	a. 1-2% A.I. concentration b. Sprayed, wipe, mop c. Estimated application frequency: 12-16 days/year d. Because the use concentration is less than 2%, exposure of these uses is considered low; however, inhalation exposure can be critical because application is generally in enclosed areas.	low	medium
4. Home/Institutional Use (toilets; washrooms; water closets; garbage cans; sinks)	a. 1-2% A.I. concentration b. Sprayed, wipe, mop c. Estimated application frequency cannot be determined d. Because the use concentration is less than 2%, exposure of these uses is considered low; however, inhalation exposure can be critical because application is generally in enclosed areas.	low	medium
5. Livestock Transport Vehicles	a. 1-2% A.I. concentration b. Estimated application frequency cannot be determined c. Not currently used d. Because the use concentration is less than 2%, exposure of these uses is considered low; however, inhalation exposure can be critical because application is generally in closed areas.	low	medium

TABLE II-5

Summary of Exposure Analysis - Non-wood Uses of Creosote, Coal Tar, and Coal Tar Neutral Oils

USE	ASSUMPTIONS USED IN ANALYSIS	EXPOSURE POTENTIAL	
		Dermal	Inhalation
6. Tree Wound Dressings	a. 97% A.I. concentration b. Brushed c. Estimated application frequency: 20-30 times/year	low	low
7. Metalworking Fluids (Cutting Oils)	a. 41.2% A.I. concentration b. Applied by metering pump or manually c. Estimated application frequency: variable, frequency unknown d. The application of this creosote product is low; however, workers exposed to cutting oils in the course of their work will have frequent dermal contact. The concentration in the oil is much less than the 41.2% product.	low	low
INSECTICIDE, MITICIDE, LARVICIDE, REPELLENT			
1. Mosquitoes Larvicide	a. Product not used for many years. More effective products available.		
2. Mosquito Repellent	a. Hand application b. Estimated application frequency: as needed c. N,N-Diethyl toluamide is much more effective.	high	low

TABLE II-5
Summary of Exposure Analysis -
Non-Wood Uses of Creosote, Coal Tar, and Coal Tar Neutral Oils

USE	ASSUMPTIONS USED IN ANALYSIS	EXPOSURE POTENTIAL	
		Dermal	Inhalation
3. Bird Repellent	a. 94% A.I. concentration b. Mixed with seed corn before planting c. Potential dietary exposure	low	low
4. Animal Repellent	a. 99% A.I. concentration b. Applied by brush or spray to wood stalls, mangers, gates, fence rails, poles, trees, and horse trailers. c. Spray is in enclosed area leading to potentially high inhalation exposure	low	high
5. Insect control Drain flies & Garbage Trucks	a. Product in question contains orthodichlorbenzene as the insecticidal agent and creosote only aids in control.		
6. Gypsy Moth Control	a. Applied by brush b. Application frequency: once/year	low	low
7. Animal Dip	a. A.I. ranges from less than 1% to 62% b. Application method by dip, swab or wash 1-2 times per year	low	low

E. Risk Assessment for Mutagenicity and Oncogenicity

1. Risk Assessment for Mutagenicity

The objective of this risk assessment is to determine whether or not the complex mixtures creosote, coal tar, and coal tar neutral oils have the potential to cause mutations in humans. This assessment is based on two kinds of available information: (1) data concerning the mutagenic potential of the complex mixtures themselves, and (2) data concerning the mutagenicity of the individual compounds that have been identified in these complex mixtures.

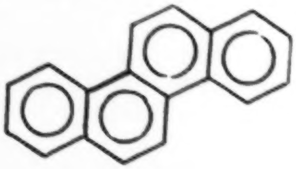
Creosote and creosote-coal tar have been shown to be mutagenic in bacteria (*Salmonella typhimurium*) and mammalian cells *in vitro* (L5178Y mouse lymphoma cells). In both test systems, the complex mixtures caused point/gene mutations in a dose-dependent manner, and the incorporation of an exogenous hepatic metabolic activation system was needed to detect these responses. In the bacterial tests, positive responses were found primarily in frameshift-sensitive tester strains; it should be emphasized that there are several known mutagens identified in creosote and creosote-coal tar (e.g., certain polycyclic aromatic hydrocarbons, aza-heterocyclic compounds, and aromatic amines) that are also primarily detected in *Salmonella* as frameshift mutagens that require metabolic activation. Creosote and creosote-coal tar were not detected as causing genetic damage in yeast tests for mitotic recombination, in *Escherichia coli* WP2 reverse mutation assays, and in differential growth inhibition tests using repair-proficient and repair-deficient strains of *Bacillus subtillus* and *E. coli*. However, because of the limitations of these submammalian tests and because of inadequecies in the studies conducted, the reported negative results are not judged as evidence for the nonmutagenicity of creosote and creosote-coal tar. This is reinforced by the positive results obtained in *Salmonella* and L5178Y mouse lymphoma cells and by the fact that these are complex mixtures of compounds some of which are clearly mutagenic. Also, there is suggestive evidence that creosote caused unscheduled DNA synthesis in cultured human lung fibroblast (WI-38) cells.

Creosote is a complex mixture of organic chemicals. Of particular toxicological concern are the polynuclear aromatic hydrocarbons (PAH's), aromatic amines, and phenolic constituents. Different creosote samples can be expected to contain varying proportions of these three as well as other broad classes of chemicals. Table II-6 presents the classification of chemicals in creosote and information on the effect associated with each class.

TABLE II-6

Classification of Chemicals in Creosote

Compound	Effect	Reference[a/]
1. Unsubstituted 6-membered aromatic ring systems (fused, unfused, or mixed)		

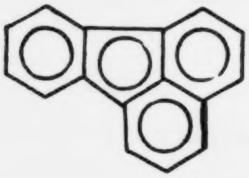


Compound	Effect	Reference[a/]
chrysene	mutagenic initiator, carcinogenic	a,b,c,d,e,s,f,r
pyrene	co-carcinogen (with fluoranthene, benzo[a]pyrene), mutagenic	f,r,b
benzo[a]pyrene	mutagenic carcinogenic, fetotoxic, teratogenic	a,b,c,d,n,o,g,r
benzo[e]pyrene	carcinogenic, mutagenic	r
benzo[a]anthracene	mutagenic, carcinogenic	a,b,c,s,g,h
benzo[c]phenanthrene	initiator, mutagenic	r
naphthalene	inhibitor	i
phenanthrene	initiator, mutagenic	r
anthracene	mutagenic	j,s
dibenzanthracene	mutagenic	s
acenaphthene	mutagenic	j,s
triphenylene	mutagenic	r

a/ The key to the references is on p. II-52

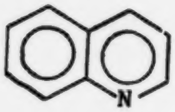
TABLE II-6 (continued)

2. Unsubstituted aromatic ring systems containing 5-numbered rings



flouranthene	co-carcinogenic, initiator, mutagenic	f,r,s
benz[j]fluoranthene	carcinogenic, mutagenic	g r
fluorene	mutagenic	s

3. Heterocyclic Nitrogen Bases

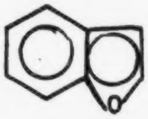


quinoline	carcinogenic	d
indole	mutagenic	s
benzocarbazoles	carcinogenic	h
isoquinoline	mutagenic	s
1-methyl isoquinoline	possibly carcinogenic	d
3-methyl isoquinoline	possibly carcinogenic	d
5-methyl quinoline	possibly carcinogenic	d
4-methyl quinoline	possibly carcinogenic, mutagenic	d,s
6-methyl quinoline	possibly carcinogenic	d
5-methyl isoquinoline	possibly carcinogenic	d
7-methyl isoquinoline	possibly carcinogenic	d
6-methyl isoquinoline	possibly carcinogenic	d
1,3-dimethyl isoquinoline	possibly carcinogenic	d
acridine	mutagenic	s
carbazole	mutagenic	s

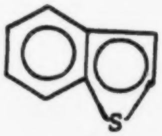
TABLE II-6 (continued)

4. Heterocyclic Oxygen and Sulfur Compounds

coumarone

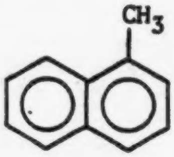


thionaphthene



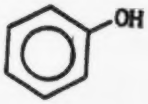
No effects found in the literature for this structural class.

5. Alkyl substituted compounds



1-methyl naphthacene	mutagenic	s
2-methyl anthracene	mutagenic	s
methyl fluoranthene	possibly carcinogenic	d
1-methyl naphthalene	inhibitor	i
2-methyl naphthalene	inhibitor	i
ethyl naphthalene	inhibitor	i
2,6-dimethyl naphthalene	inhibitor	i
1,5-dimethyl naphthalene	inhibitor	i
2,3-dimethyl naphthalene	accelerator	i
2,3,5-trimethyl naphthalene	inhibitor	i
2,3,6-trimethyl naphthalene	accelerator	i
methyl chrysene	initiator	p,q
1,4-dimethyl phenanthrene	initiator, mutagenic	r
1-methylphenanthrene	mutagenic	r,s

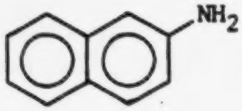
6. Hydroxy compounds



phenol	promoter	f,m
p-cresol	promoter	m
o-cresol	promoter	m
m-cresol	promoter	m

TABLE II-6 (continued)

7. Aromatic amines



2-naphthylamine	carcinogenic	l
p-toluidine	carcinogenic	m
o-toluidine	carcinogenic	m
2,4-xylidine	carcinogenic	m
2,5-xylidine	carcinogenic	m

8. Paraffins and naphthenes

$\left[-CH_2- \right]_n$ (n is large, e.g., greater than 15)

No effects found in the literature for this structural class.

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* classes taken from McNeil (1952).
a. McCann et al. (1975)
b. Thilly and Liber (1979)
c. Nagao and Sugimura (1978)
d. Hollstein et al. (1979)
e. Sivak (1979)
f. Van Duuren (1976)
g. IARC (1973)
h. CAG (1978b)
i. Schmeltz et al. (1978)
j. Epler et al. (1979)
k. Boutwell and Bosch (1959)
l. IARC (1974)
m. Weisburger et al. (1978)
n. Wyrobek and Bruce (1975)
o. Epstein et al. (1972)
p. Van Duuren (1966)
q. Van Duuren and Goldschmidt (1976)
r. IARC, 1983, Vol. 32.
s. Vaughn-Dellarco, (1983)

The overall evaluation of the data regarding the mutagenic activity of creosote, coal tar, and coal tar neutral oils and the data regarding the mutagenic activity of the individual compounds identified in creosote and creosote-coal tar suggests that creosote and creosote-coal tar have the potential of mutagenicity in intact mammals including humans. It should be emphasized, that creosote and creosote-coal tar were evaluated only in *in vitro* tests and that testing in intact mammals has not been performed. When determining the risk posed by exposure to a mutagenic agent, several factors (e.g., absorption, metabolism) may alter the mutagenic response in the whole mammal compared to the mutagenic potential determined *in vitro*. Although creosote and creosote-coal tar are judged as potential mammalian mutagens that may cause somatic mutations (and somatic mutations may be involved in the etiology of cancer), the data concerning genetic risk with respect to germ cells are too limited for any conclusions at present.

2. Risk Assessment for Oncogenicity

Creosote and coal tar and many of their component chemicals have been well characterized as carcinogens in laboratory animals (PD-1, Coal tar, Creosote, and Coal Tar Neutral Oils; PD-2/3 Wood Preservatives; IARC, 1973, 1983). These studies, along with the several reports in the literature of skin cancer in people exposed to creosote and coal tars, suggest that these chemicals are human carcinogens, even though no valid epidemiology studies have been performed of workers using creosote or creosote/coal tar blends (CAG, 1977, 1982).

Two hundred years ago, scrotal cancer was observed in English chimney sweeps (Pott, 1775). Since that time, several reports have confirmed cases of cancer in humans resulting from industrial exposure to coal tars (NIOSH, 1977). As noted in the oncogenicity rebuttal section, Shambaugh (1935) reported that fishermen who held tar-soaked needles in their mouths while mending tarred nets, developed lip cancer as a result. In an analysis of the study of wood treatment plant workers, the Agency notes that there were significant increases in benign growths and pseudofolliculitis in the study population (Tabershaw, 1979). These eruptions occurred where clothing rubbed against the skin rather than in areas exposed to the sun, suggesting that these effects were caused by exposure to the creosote preservative through the clothing.

Substantial epidemiological evidence is available to show that exposure to coke oven emissions gives rise in workers to an excess risk of death from lung cancer and cancers of the bladder, prostate, pancreas, and large intestine (CAG, 1978a). The airborne chemicals comprising coke oven emissions are condensed to form coal tars.

Creosote, coal tar, and many of the individual chemicals comprising these mixtures have been subjected to animal carcinogenesis assays and short term mutagenesis assays in the laboratory.

A CAG report (1977) summarizes several mouse skin painting studies (Woodhouse, 1950; Poel and Kramer, 1957; Lijinsky _et al_., 1957; Boutwell and Bosch, 1958) in which creosote was found to cause skin papillomas and carcinomas. In one study (Roe _et al_., 1958), lung adenomas were observed as well as skin tumors in mice receiving dermal applications of creosote oil.

The CAG report also summarizes numerous skin painting studies in which coal tars produced skin cancer in mice and rabbits. In addition, tumors of the lung were reported in mice inhaling coal tar aerosols (Horton _et al_., 1963).

Coal tar neutral oils have been shown to be oncogenic in laboratory animals. For example, Berenblum and Schoental (1947) tested several coal tar neutral oil fractions in mice and rabbits. Most fractions were found to be oncogenic. In 1961, Horton showed that extracts (in maleic anhydride) of coal tar neutral oils produced tumors in mice in about 33 weeks. Earlier, however, Cabot et al. (1940) applied benzene solutions of benzo[a]pyrene with and without coal tar neutral oil to the skin of albino mice. The coal tar neutral oil was found to inhibit the tumorigenic response of benzo[a]pyrene.

A series of aromatic amines, among them some monocyclic amines occurring in creoste (Nestler, 1974), were tested for long-term toxicity by dietary administration to Charles River rats and HaM/ICR mice (Weisburger et al., 1978). Of these amines, ortho- and para-toluidine, 2,4-xylidine, and 2,5-xylidine led to tumors in various tissues. Meta-toluidine had questionable activity. The boiling points of these compounds range from 200°C to 215°C. Chrysene, one of the major components of creosote, is a 4-ring polynuclear aromatic hydrocarbon (PAH) which boils at 448°C. As reviewed by the IARC (1973, 1983), chrysene causes skin tumors in mice. In addition, it acts as an initiator of skin cancer in mice. (The oncogenicity of chrysene is presently under review by EPA's Carcinogen Assessment Group.)

Because coal tar contains an additional, higher boiling spectrum of coke oven volatiles than creosote, it contains a large number of 5- and 6-ring (PAH's). The carcinogenicity of many of these larger PAH's has been studied and reviewed extensively (CAG, 1978b; IARC, 1973, 1983). Known PAH carcinogens in coal tar are benz[a]anthracene, benz[a]carbazole, benzo[b]fluoranthene, benzo[i]fluoranthene, benz[c]acridine, benzo[a]pyrene, benzo[e]pyrene, chrysene, dibenzo[a,i]anthracene, dibenz[a,h]anthracene, dibenzo[a,h]pyrene, dibenzo[a,i]pyrene, and indeno[1,2,3-cd]pyrene.

A number of chemicals in creosote and coal tar act as co-carcinogens, initiators, accelerating agents, and inhibitors. These chemicals were reviewed in PD 2/3, Wood Preservatives and IARC, 1983. (See Table II-6, II-49). These chemical agents will affect the carcinogenic potential of creosote and cresote/coal tar blends. Because of synergism among these components, the carcinogenic potency of creosote or its coal tar blends cannot be predicted by assaying samples of the mixture for single carcinogenic components. Early attempts to correlate carcinogenic potency with quantitative analytical determinations of individual carcinogens in creosote (Lijinsky et al., 1957) and petrochemical fractions (Bingham et al., 1980) have been unsuccessful. Recently, some researchers have interpolated potencies for complex mixtures of hydrocarbons by comparing short tests with epidemiology data for marker chemicals or results of chronic bioassays in laboratory animals. These methods are still being evaluated by the scientific community. Their application to creosote or its coal tar blends for risk assessment purposes would require sophisticated sampling of the materials to which users are exposed.

In addition to the fact that creosote and coal tar are well characterized as animal carinogens, the several individual case studies provide strong evidence of its potential as a human carcinogen. Along with the case for oncogenicity of whole creosote and coal tar, many of the individual component chemicals have been shown to be carcinogens. The variable nature of creosote and creosote/coal tar blends, the complex nature of the material and the toxicological synergism of its constituents preclude the use of a single component chemical as an index of exposure for use in a quantitative risk assessment.

3. Conclusion

The exposure data indicate that applicators of products containing creosote, coal tar, and coal tar neutral oils used for non-wood purposes are subject to both dermal and inhalation exposure during the application process. These products are applied by brush, by spray, wiped on or the object/animal is dipped into the chemical.

Two of the currently registered uses, on seed potato storage premises and equipment and on seed corn as a crow repellent, are considered food uses requiring the establishment of tolerances under Section 408 of the Federal Food, Drug, and Cosmetic Act. There exists a potential for dietary exposure as a result of these two uses. The livestock and poultry premise treatment uses are considered to be non-food uses.

The Agency has determined that the use of products containing creosote, coal tar, and coal tar neutral oils for all non-wood purposes, poses a risk of oncogenicity and mutagenic effects to the applicators. There is also potential risk as a result of dietary exposure to these chemicals through the two uses considered to be food uses as described above.

III. BENEFITS ANALYSIS

A. Introduction

Part III contains the benefit analysis for the non-wood uses of croesote, coal tar, and coal tar neutral oils. This analysis is based on material presented in the report "The Biologic and Economic Assessment of Pentachlorophenol Inorganic Arsenicals, and Creosote, Volume II: Non-Wood Preservatives" prepared by the United States Department of Agriculture (USDA), state agencies, and EPA. Additional information was taken from the report entitled "Use and Exposure Assessment of Coal Tar, Creosote, and Coal Tar Neutral Oil for Nonwood-Preserving Pesticidal Application" prepared by The Mitre Corporation, 1981 under EPA Contract No. 6801-5944.

There are several non-wood uses of creosote, coal tar, and coal tar neutral oils. For each specific use the following information is presented: usage, alternative chemicals registered with the Agency for the same use, and the economic impact if the registration of creosote, coal tar, and coal tar neutral oils were cancelled for the specific use.

For each use, alternative chemicals registered for the use are discussed. In general, risk posed by the continued use of the creosote, coal tar, and coal tar neutral oils products is greater that that posed by alternative chemicals. All of the alternatives are scheduled for review in the Registration Standards (RS) program. It will be noted by each alternative chemical only whether the chemical is currently undergoing RS review, has completed RS review, or if the chemical is or has been in RPAR/Special Review.

B. Ornamental Flowering Plants and Ornamental Lawns

1. Usage

Creosote is currently registered as a herbicide for use on ornamental flowering and ornamental lawns to control nutgrass. For this use creosote is blended with petroleum distillates and applied directly as a foliar spray. There is no information available on the amount of these products used for this purpose. USDA personnel as well as turfgrass experts and weed scientists are not aware of creosote products used for this purpose.

2. Alternatives

Several currently registered alternatives to creosote for use on ornamental flower gardens are: dichlobenil; alachlor (RS in progress); simazine (RS in progress); metolachlor (RS completedproduct reregistered); metolachlor plus tank mix with Princep® 80W, 4L, or simazine. Registered alternatives for use on lawns and turf include: bentazon; methanearsonic acid; AMA with 2,4-D; DSMA; and MSMA (RS completed - product reregistered).

3. Economic Impact

There are a number of federally registered effective alternatives to creosote for use on ornamental flower gardens and ornamental lawns to control nutgrass. Use of creosote for this purpose is unknown and cannot be verified. Cancellation of this use would have no economic impact.

C. Product Storage Yards

1. Usage

Creosote and coal-tar solutions have also been used by the wood-preserving industry for the control of weeds and grass on product storage yards. This use was one of convenience rather than necessity because of the availability of the products to the wood-preserving industry. However, this use has been substantially curtailed because of pollution control regulations.

2. Alternatives

Information with regard to the usage of several available alternatives is not available. However, it is generally agreed upon by turfgrass experts, weed scientists, and USDA personnel that the coal-tar products are poor substitutes for several alternative herbicides currently available.

3. Economic Impact

There are a number of federally registered alternatives to creosote and coal-tar solutions to control weeds and grass. Cancellation of this use would have no economic impact.

D. Agricultural Premises and Highway Rights-of-Way

1. Usage

Coal-tar creosote is registered for use on agricultural premises along fencerows and along highway rights-of-way for general weed control. There is no information on the annual poundage of these products used for this purpose.

2. Alternatives

The 1983 Weed Control Manual lists many possible alternative chemicals registered for this use. Some of the many alternatives that are registered and can be used are: atrazine, 2,4-D, dicamba, amitrole (RS completed), ammonium sulfamate (RS completed - product reregistered), MSMA, asulam, bromacil, dalopon, MCPA (RS completed - product reregistered), and hexazinone (RS completed - product reregistered).

3. Economic Impact

There are a number of federally registered alternatives to coal-tar creosote solutions for general weed control. Cancellation of this use would have no economic impact.

E. Rope and Canvas Tarpaulins

1. Usage

One product, M&S Creosote Oil®, is registered for use as a fungicide on rope and canvas. Data collected from rope manufacturers indicated that this use is an old practice to protect ropes from decay before the widespread use of synthetic-fiber rope. Synthetic-fiber rope does not require a preservative.

M&S Creosote Oil® is the only coal-tar base product registered for use on canvas products to make them resistent to the growth of algae and fungi. Additionally, this product provides some resistance to water penetration. Specifically, this product was used to rotproof sand bags. In 1980, representatives of the Canvas Product Association and canvas product finishers were not aware of any use of this product on canvas products.

Approximately 4,000 gallons of this product are produced annually and is marketed through hardware stores. However, estimates on the quantities of the product used on rope and canvas are unknown.

2. Alternatives

The major alternative to the use of coal tar-based products on rope is the substitution of natural fibers by synthetic fibers. Alternatives to the creosote product for use on canvas products are: mercury-containing fungicides including phenylmercury triethanolamine lactate, phenylmercury triethanolamine proprionate, and commercial mercury; and copper-containing fungicides such as copper carbonate-ammonium zirconyl carbonate and copper 8-quinolinolate. None of these alternatives imparts the secondary effect of water repellency.

3. Economic Impact

The cancellation of the coal-tar products for use on rope and canvas products would have a minor economic impact.

F. Seed Potato Storage Premises and Equipment

1. Usage

The purpose of the seed potato industry is to provide seed for commercial potato production for the next year's growing season. Disinfectants are used to control a highly infectious tuber disease called ring-rot. Bacterial ring-rot is spread through the use of diseased seed pieces, contaminated equipment and contaminated shoes or premises. The presence of ringrot in even one potato will disqualify the entire crop from certification by USDA. The disinfectant is used on: seed potato storage bins; the interior of the building; all equipment entering the building potentially coming in contact with the seed potato including crates, barrels, baskets, the potato harvester, and trucks transporting the potatoes from the field to the storage facility.

The only registered coal tar product used by the seed potato industry is Kotarol®. This product is distributed to seed potato growers throughout the Northeast United States. In considering the five major potato producing areas, significant amounts of coal tar are used only in Maine. According to 1980 usage data, approximately 2600 gallons of coal tar disinfectant are used by seed potato growers in Maine each year.

The use of creosote, coal tar, and coal tar neutral oils on seed potato premises and equipment is considered to be a food use requiring the establishment of tolerances under Section 408 of the Federal Food, Drug, and Cosmetic Act.

2. Alternatives

Alternative disinfectants for this use include: quaternary ammonium compounds, formaldehyde (scheduled for review under the Toxic Substances Control Act), and chlorine compounds. Efficacy studies have shown that formaldehyde products are equally effective as the coal tar product against ring-rot bacteria.

3. Economic Impact

Efficacy data cannot be used to conclude that the seed potato industry represents a critical use for coal tar disinfectants. Additionally, the seed potato use is considered a food use and, therefore, in the absence of appropriate tolerances the use should be cancelled. The cancellation of the coal tar products for this use would not have a significant economic impact on the industry but a complete cost/benefit analysis based on current usage data must be done before a final regulatory decision is issued.

G. Livestock Premises

1. Usage

Creosote, coal tar, and coal tar neutral oils are acknowledged to be widely used as general livestock disinfectants by the producers and distributors of these products. However, specific end-use information is not obtainable due to the fact that these products are purchased over-the-counter by individual livestock farmers. The use of these products in livestock premises is not considered a food use provided proper restrictions are on product labels.

Use patterns of these disinfectants vary regionally depending on the type of livestock in a specific area. Data from producers and distributors of these coal tar products indicate that the majority of these products currently used by livestock farmers is to disinfect livestock buildings and equipment. These products are not the primary disinfectant used by large-scale commercial producers.

2. Alternatives

Alternatives for the coal tar disinfectants include: synthetic phenol, cresylic acid, iodophers, hypochlorites (RS completed - product reregistered), and quaternary ammonium chlorides.

3. Economic Impact

The cancellation of this use is not expected to have a significant economic impact.

H. Poultry Premises

1. Usage

Disinfectants containing creosote, coal tar, and coal tar neutral oils were widely used in the poultry industry at one time. However, the use of these products on poultry premises has diminished. In 1971, EPA cancelled the registrations of coal tar neutral oil/coal tar acid combination products used in poultry houses. The use of these products in poultry premises is not considered a food use provided proper restrictions are on product labels.

2. Alternatives

Alternative chemicals being used as disinfectants in poultry houses include: quaternary ammonium chlorides and synthetic phenolic compounds; cresylic acid; and formaldehyde (scheduled for review under Toxic Substance Control Act). A non-chemical method of controlling primarily bacteria and viruses involves the reuse of litter. Litter is allowed to build up for a period of 1 to 2 years. The build-up of litter involves an anaerobic decay process involving heat which serves as a disinfectant and kills bacteria, viruses, and parasitic ova.

3. Economic Impact

The cancellation of this use is expected to have no economic impact.

I. Home and Institutional Use

1. Usage

Several products containing creosote, coal tar, and coal tar neutral oil are registered for home and institutional use. Registered use sites include: floors, walls, cellars, toilet rooms, sinks, washrooms, toilets, garbage cans and garbage handling equipment, water closets, and urinals. However, current use unrelated to farm use is unlikely. The major reason for the lack of this use at most sites is the strong, unpleasant odor associated with the products.

2. Alternatives

Alternatives to the coal tar containing products for this use include: pine oils, phenolics, chlorine, and iodophors.

3. Economic Impact

The cancellation of this use is not expected to have a significant economic impact.

J. Transportation Vehicles

1. Usage

Products containing creosote, coal tar and coal tar neutral oil are used in transportation vehicles (airlines, buses, trains, trucks) to disinfect tables, seats, walls, toilets, and sinks. There is no currently reported use of these products at these sites.

2. Alternatives

Alternatives to the coal tar-containing products for this use include: quaternary ammonium chlorides, substituted phenols, and iodophors.

3. Economic Impact

The cancellation of this use is expected to have no significant economic impact.

K. Tree Wound Dressings

1. Usage

Creosote is currently registered for use as a tree wound dressing to prevent decay in damaged trees. One product registered for this use is M&S Creosote Oil®. An estimated 4,000 gallons of this product is produced annually but usage for this site is unknown. A second product, Staffel's Tree Dressing®, is no longer produced.

Toxicity tests show that fibrated asphalt paint plus creosote applied to tree wounds caused some consistent injury to cambrium tissue at the margin of the wound and reacts unfavorably on the tree's natural healing process.

2. Alternatives

Tree sevice companies indicate that asphalt-based compounds were the most commonly used products for tree wound dressing. Scientific data indicate that tree wound dressing is of questionable value and may only serve a cosmetic function.

3. Economic Impact

The cancellation of this use is expected to have no economic impact.

L. Metalworking Fluids

1. Usage

One product, Wescol®, containing coal tar acids, coal tar phenols, cresylic acids, creosote, plus two substituted sodium phenates, is registered for use as a bactericide-fungicide in metalworking fluids (also called cutting oils). As of January, 1980 there was no production or sales of this product.

2. Alternatives

At least 65 products are registered as alternatives to the single product containing coal tar/creosote. These products are divided into two main types of formulations: formaldehyde-releasing chemicals and non-formaldehyde-releasing chemicals. In general, formaldehyde-releasing products do not have a wide antimicrobial spectrum of efficacy as do the non-formaldehyde-releasing products in that activity against fungi is limited. Industry sources have stated that these two general classes of metalworking additives are used alternatively or in combinations to inhibit the growth of bacteria and fungi.

3. Economic Impact

The cancellation of this product will have no economic impact.

M. Mosquito Larvicide

1. Usage

The neutral oil coal-tar acids are registered for use in the control of mosquito larvae. These products are sprayed onto the surface of stagnant waters forming a film which obstructs the breathing of the immatured aquatic forms. Current usage of these products in the U.S. mosquito control programs is very limited if at all.

2. Alternatives

Mosquito larvae can be effectively controlled by covering the surface of the water in which which they occur with a petroleum distillate of low volatility.

3. Economic Impact

Since the use of neutral oil coal-tar acids is insignificant cancellation of the registratioons would not be detrimental to current mosquito control activities nor result in a significant economic impact.

N. Animal Repellents

1. Usage

Creosote, coal tar and neutral oil products are used as animal repellents. Information on the quantity of use of these products as animal repellents is not available and it cannot be verified that these products are used for all repellent uses for which they are registered.

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One registered use is on lawns and flower beds to discourage the use of these areas by dogs.

Creosote oil is registered for use on wood stalls, mangers, gates, fence rails, posts, trees, trailer sides, and similar wooden structures to prevent horses from cribbing, biting, gnawing, or licking on the wood of these various structures. Data indicate that there are approximately 8.5 million horses in the United States and 3.2 million horse owners. While it is difficult to determine the extent of creosote oil used for horse cribbing, probable usage is under 100,000 gallons annually.

2. Alternatives

No alternatives to the use of the coal tar products on stalls and wooden fences to prevent cribbing by horses are available except for another coal tar distillate product, anthracene oil.

3. Economic Impact

Price comparisons per quart for creosote and anthracene oil indicate that anthracene oil products are less expensive than the creosote oil products. Equal amounts of both of these pesticides cover the same square footage of wood, and manufacturers of these pesticides indicate that both products remain effective for several years. Cancellation of this creosote would not result in a significant economic impact.

O. Bird Repellent

1. Usage

Coal tar products are used in treating seed to prevent or discourage the ingestion of seed by birds. One currently registered product, containing a blend of creosote and neutral oil, is used as a crow repellent on seed corn. This product has been on the market for over 50 years and is used primarily in an area extending from the northeastern United States through Texas and along the eastern seaboard. The product has limited use in the midwestern and western U.S. due to the absence of a crow problem.

Another coal-tar distillate product registered for use as a bird repellent has been out of production since 1978. This use of creosote, coal tar, and coal tar neutral oils is considered to be a food use requiring the establishment of tolerances under Section 408 of the Federal Food, Drug, and Cosmetic Act.

2. Alternatives

There are several products that can be used as alternatives to the coal tar product for bird repellents. Copper oxalate is used for this purpose, the cost is comparable to the coal-tar product, and the application is simpler.

Mesurol®, 4-(methylthio)-3,5-xglyl methylcarbamate, is also reported to be widely used as a repellent on corn and other seed. This product is preferred by some planters over the coal tar product since it acts as an insecticide as well as a bird repellent. Mesurol® is 3-4 times more expensive than either copper oxalate or the coal tar products.

Tetramethylthiuram disulfide (thiram - in RS process) is widely used as a bird, rodent, and deer repellent but is also effective as a fungicide. It is used to treat a variety of seed types and as a foliar spray to discourage browsing by deer and rabbits.

Anthraquinone has been used as a bird repellent on pine seed in direct seeding of open lands in the southern part of the U.S. This chemical is widely used in the paper industry and as a dye stuff.

Nonchemical alternatives available for crow repellents include: exploders, traps, nets, and broadcasting amplified alarm or distress calls.

3. Economic Impact

Data indicate that Mesurol® and thiram are more expensive per bushel of seed corn than the coal-tar product but copper oxalate is the same price as the coal-tar product.

A cancellation of the coal tar product should not create any cost impact.

P. Insect Repellent

1. Usage

Coal tar is currently registered for use as an insect repellent in preparations intended for use on human skin, except for the forehead. This product is supposed to repell gnats, mosquitoes, and deer flies. There is no evidence to indicate that this coal tar product is still produced and marketed for use as an insect repellent.

2. Alternatives

There are approximately 110 registrations for products that are potential alternatives for coal tar as an insect repellent. N,N-diethyl-meta-toluamide (RS review completed - product reregistered) whether alone or in combination with other chemicals is the active ingredient in about 103 of the registered products and is considered to be highly effective.

3. Economic Impact

Because this product is not being produced or marketed, cancellation of this use would have no economic impact.

Q. Screwworm Control

1. Usage

There is one creosote product currently registered for treatment of screwworms in horses and mules. Data confirming actual use and quantities used are not available.

2. Alternatives

Alternatives for control of screwworms in farm animals include: coumaphos, ronnel, lindane in pine oil, and diphenylamine in benzene. While no coal-tar distillate product is included in the list of recommended control chemicals and formulation, there is indirect evidence to indicate that the products are used for screwworm control.

3. Economic Impact

Cancellation of the creosote product would have little, if any, economic impact. Although actual use cannot be confirmed it is considered to be negligible.

R. Insect Control

1. Usage

Coal tar products are registered as larvicides and disinfectants for use to control maggots and flies in garbage trucks and neutral-oil products are also used to control drain flies and their maggots in drain lines.

There is one product registered for use on drain lines. The label of this product claims "kills drain flies". However, one of active ingredients in this product is orthodichlorobenzene which is clearly the insecticidal agent.

2. Alternatives

Alternatives to the coal-tar products for this use include: ronnel, methoxychlor, and orthodichlorobenzene.

3. Economic Impact

Cancellation of these coal tar products for this use would not result in a significant economic impact.

S. Gypsy Moth Control

1. Usage

Neutral-oil containing products and creosote are used in the regulatory treatment in the control of the gypsy moth egg masses by the USDA Plant Protection and Quarantine Program. Control efforts are focused on finding and either treating or destroying the egg masses of the gypsy moth that are found during inspection of products being shipped out of quarantine areas. A standard practice is to search mobile homes, or materials to be moved for egg mass deposits. Visible egg masses are scraped from the surface of the object. In areas where egg masses are hidden or difficult to reach, creosote is applied by brush to kill the eggs. If egg masses are found on forest products, vehicles, or other products, they are coated with the coal-tar distillate in undiluted form.

Under 100 gallons/year of neutral-oil product is utilized in this control program. The use of this product is considered essential by USDA for preventing economic destruction by the gypsy moth in presently non-infested areas as well as preventing the future use of large amounts of insecticide to control the problem.

2. Alternatives

Presently there are no registered alternatives to the coal-tar distillates for regulatory treatments of gypsy moth egg masses. The USDA has conducted some research with common household disinfectants such as Pine Sol®, detergents, etc., and finds them to be as effective as the creosote products.

3. Economic Impact

Cancellation of these neutral-oil containing products and creosote are not expected to result in a significant economic impact.

T. Animal Dip

1. Usage

Coal tar distillates, including coal tar, have been used as disinfectants for at least a century to control parasites, such as ticks and mites, on animals. The present use of these products is restricted to use on horses, mules, dogs, and other non-food animals. While large animals are wet down with a water emulsion formulation, small animals may be immersed, sprayed, or bathed in the material.

For dogs, there are two products registered by the EPA for control of fleas, lice and sarcoptic mange; one product for fleas and lice; one for lice alone; and one for sarcoptic mange alone. For horses, there are two products registered by the EPA for control of both lice and psoroptic mange mites.

2. Alternatives

Over 80 alternatives are registered for use on dogs for lice and over 100 substitute chemicals are available for flea control. The chemicals most frequently recommended by state agencies for flea control are: carbaryl, coumaphos, DDVP, malathion, methoxychlor, and rotenone. Chemicals recommended by state agencies for lice control are carbaryl and malathion. The USDA does not recommend coal-tar/creosote/coal-tar neutral oils for use to control fleas or lice on dogs.

There are approximately 40 chemical alternatives registered for use on horses to control lice and over 10 alternatives for equine psoroptic mange mite control. The chemicals most frequently recommended by state agencies for lice control on horses are: coumaphos, dioxathion, malathion, and toxaphene. The USDA recommends coumaphos, crotoxyphos, dioxathion and malathion for lice control on horses.

3. Economic Impact

Alternatives to the coal-tar distillates used as insecticides to control parasites on non-food animals are numerous. The cancellation of this use would not result in a significant economic impact.

PART IV: DEVELOPMENT OF REGULATORY OPTIONS

A. Introduction

In Parts II and III, the Agency identified the risks and benefits of the non-wood uses of creosote, coal tar, and coal tar neutral oil. As explained in Part I, FIFRA requires the Agency to determine if the use of a pesticide meets the statutory standard for registration by balancing the risks and benefits of use. To carry out this mandate, the Agency has developed a range of regulatory measures which are intended to reduce the risks of use for the pesticides under review. Part IV discusses the factors which have been taken into account in developing the regulatory options for the non-wood preservative uses of creosote, coal tar, and coal tar neutral oil and describes in detail those measures selected for futher consideration in Part V.

B. Basis and Rationale for Developing Options and Modifications

There are three basic options for regulating all pesticides:

Option 1 - Continuation of Registration without changes

Option 2 - Continuation of Registration with Modifications to Terms and Conditions of Registration

Option 3 - Cancellation of Registration

The two extreme options, Option 1, Continuation of Registration without change and Option 3, Cancellation of Registration, are at opposite ends of the risk/benefit spectrum. Adoption of Option 1 would be appropriate when the Agency has concluded that the level of risk is acceptable in light of the pesticide's benefits and that further risk reduction measures are not necessary to assure that the use of the pesticide meets the statutory standard for continued registration.

Adoption of Option 3, Cancellation, would be appropriate when the Agency has concluded that the risks from a use outweigh the benefits of that use, and that these risks cannot be mitigated to an acceptable level, in light of the benefits, by any other measures short of cancellation. Cancellation prohibits the sale or the distribution of a pesticide for a particular use or uses. The effect of cancellation is to entirely eliminate the risks of a pesticide's use or uses as well as the benefits. Cancellation may affect all uses of a compound, or it may affect only specific uses, specific formulations, or specific application methods.

Option 2 is appropriate when the risks of a pesticide use can be reduced to an acceptable level, while preserving the benefits of the use. This risk reduction is accomplished by modifying the terms and conditions of the pesticide's registration. These modifications, which are expressed through the pesticide's labeling are, for the most part, changes in the way the pesticide is used. These changes are designed to reduce exposure to the pesticide, and thereby reduce or even eliminate the risk from the pesticide.

C. Discussion of Option 2, Modifications to the Terms and Conditions of Registration

The specific risk reducing modifications which the Agency has selected for further consideration are presented in this section.

1. Require Protective Clothing: Impermeable Gloves

Risks associated with exposure to all of the oncogenic or mutagenic components of creosote could not be quantified. Although there are many human case reports of human skin cancer among creosote applicators (EPA,1981) there are no studies available which can be used for a quantitative risk extrapolation of low levels of exposure. To reduce the risk caused by dermal exposure for uses of creosote, the Agency will consider that all applicators using creosote must wear gloves impervious to these pesticides in all situations when dermal contact with them is possible.

This modification would require applicators to wear gloves made of material impervious to the creosote, coal tar, and coal tar neutral oil-containing products. Gloves would be required when mixing the product, during actual application, and when cleaning application equipment, such as brushes.

This protective clothing modification would apply to all of the non-wood use categories of creosote, coal tar, and coal tar neutral oil products and all applicators. When applying these products by brush, by wiping or mopping, or when objects/animals are dipped into the chemicals, the primary site of dermal exposure is on the hands. Although adequate experimental data are not available on the permeability of gloves to these products, the Agency estimates that appropriate gloves will reduce dermal exposure through the hands by 90% in most use situations (EPA, 1984, PD-4). This reduction assumes no pesticide penetration through the gloves, and a small possibility of some exposure around the cuff (EPA, 1984, PD-4).

2. Require Protective Clothing: Respirators

This modification would require that applicators involved in spraying creosote, coal tar, and coal tar neutral oil-containing products wear respirators. Use sites where these products can be applied by spray are: seed potato storage premises and equipment; livestock premises; poultry premises; home/institutional use; livestock transport vehicles; animal repellent (on seed corn). Proper use of respirators would be expected to reduce high inhalation exposure during the application. The use of a half-mask canister or cartridge respirator capable of trapping pesticide particulates and vapors would reduce potential inhalation by about 90% (EPA, 1984, PD-4).

3. Require Protective Clothing: Coveralls

This modification would require persons applying creosote, coal tar, and coal tar neutral oils to wear protective clothing, such as disposable coveralls, to reduce risks to a greater degree than the risk reduction from gloves alone. This modification would apply to all non-wood uses of these chemicals.

4. Disposal of Protective Clothing

This modification would require applicators of creosote, coal tar, and coal tar neutral oils to: change protective clothing showing obvious signs of contamination; launder non-disposable clothing separately from other household clothing; clothing and workshoes or boots must be disposed of in any general landfill, in the trash, or in any other manner approved for pesticide disposal.

5. Prohibit Eating, Drinking and Smoking During Application

This modification would prohibit home and commercial applicators from eating, drinking, and smoking when applying any of the creosote, coal tar, and coal tar neutral oil products. This modification would apply to all non-wood use categories of these chemicals. If adopted, this modification would reduce the applicator's oral exposure to these products and would greatly reduce the opportunity for accidental ingestion of these pesticides by homeowners.

6. Restricted Use

The Agency is concerned about the possibility of high exposure to applicators who have not been properly trained in the safe handling procedures for formulations of creosote products which could be obtained "over-the-counter." Of concern to the Agency is the potential for high exposure to products requiring spraying and to products requiring mixing and/or diluting where there could be some splashing of the formulation resulting in dermal and inhalation exposure.

To protect the applicator from these potentially high exposures to creosote products, the Agency proposes that the sale and use of creosote products be restricted to certified applicators or by persons under their direct supervision and only for those uses covered by the certified applicator's certification.

7. Interior Application Prohibited

This modification prohibits the use of creosote, coal tar, and coal tar neutral oils from being applied indoors.

PART V: PROPOSED REGULATORY DECISION

As stated in Part IV, the Agency has developed three basic regulatory options to be considered with respect to pesticide products containing creosote, coal tar, and coal tar neutral oils that are used for non-wood purposes:

1. Continuation of registration without changes.
2. Continuation of registration with modification to terms and conditions of registration
3. Cancellation of registration.

A. Risk/Benefit Analysis of Regulatory Options, Use-by-Use

1. Ornamental flowering plants and ornamental lawns

If registrations of creosote products were continued without restriction both commercial applicators as well as homeowners would continue to be exposed via spray treatments and at risk to cancer. The benefits associated with this use are inconsequential because of the numerous alternatives available. The necessity use of these products for this purpose is unknown and cannot be verified.

If registrations of creosote products were continued with amended terms and conditions, the following provision would apply: all applicators would be required to be certified and to wear respirators and impermeable gloves. Exposure and subsequent health risks would be reduced but the risks would still outweigh the benefits for this use.

If registrations of creosote products for this use were cancelled, all risks to the applicators and homeowners from these products would be eliminated. Cancellation of this use would have no economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of creosote products, the Agency has determined that the risks outweigh the benefits for Options 1 and 2. Therefore, the Agency proposes to cancel the use of the creosote products for use on ornamental flowering plants and ornamental lawns.

2. Product Storage Yards

If the registrations of creosote and coal tar products for use on product storage yards for general weed control were continued without restriction, applicators would continue to be exposed via spray treatments. These products have been used by the wood preserving industry as a matter of convenience rather than necessity. Use has been curtailed due to pollution control regulations applicable to the wood-preserving industry. Numerous alternatives are available. For these reasons, there are no benefits associated with this use.

If registrations of these products were continued with amended terms and conditions, the following provision would apply: all applicators would be required to be certified and wear respirators and impermeable gloves. Exposure and subsequent health risks would be reduced but the risks would still outweigh the benefits.

If registrations of these tar products were cancelled for this use, all risks to applicators would be eliminated. Cancellation of this use would have no economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of creosote and coal tar products, the Agency has determined that the risks outweigh the benefits for Options 1 and 2. Therefore, the Agency proposes to cancel the use of the creosote and coal tar tar products for use in product storage yards.

3. Agricultural Premises and Highway Rights-of-Way

If registrations of coal-tar/creosote products were continued without restriction, applicators would continue to be exposed via spray treatments to these chemicals. The benefits associated with this use are insignificant because there are numerous alternative chemicals registered for this use. There is no information on the annual poundage of these products used for this purpose.

If registrations of these products were continued with amended terms and conditions, the following provision would apply: all applicators would be required to be certified and wear respirators and impermeable gloves. Exposure and subsequent health risks would be reduced but the risks would still outweigh the benefits.

If registrations of these products were cancelled for this use, all risks to applicators would be eliminated. Cancellation of this use would have no economic impact.

Having evaluated the cancer and mutagenic risk associated with creosote and coal tar products for use on highway rights-of-way. with this use of coal-tar/creosote products, the Agency has determined that the risks outweigh the benefits for Options 1 and 2. Therefore, the Agency proposes to cancel the use of the creosote and coal tar products for use on agricultural premises and highway rights-of-way.

4. Rope and Canvas Tarpaulins

If the registration of a coal tar base product was continued without restriction for use on rope and canvas tarpaulins, applicators would continue to be exposed during the process of dipping ropes and canvas products into these chemicals. The benefits associated with continued use of this product are insignificant and actual usage cannot be verified. Various chemical alternatives exist but the major alternative is the substitution of natural fibers with synthetic fiber in manufacturing rope.

If the registration of this product was continued with amended terms and conditions, the following provision would apply: all applicators would be required to be certified and wear impermeable gloves. Exposure and subsequent health risks would be reduced but the risks would still outweigh the benefits.

If the registration of this coal tar base product were cancelled for this use, all risks to applicators would be eliminated. Cancellation of this use would have only a minor economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of this coal-tar base product, the Agency has determined that the risks outweigh the benefits for Options 1 and 2. Therefore, the Agency proposes to cancel the use of the coal tar products for use on rope and canvas tarpaulins.

5. Seed Potato Storage Premises and Equipment

If the registration of the coal tar product used as a disinfectant to control ring-rot bacteria in seed potato storage premises and equipment was continued without restriction, applicators would continue to be exposed to this chemical during the spray treatment. This use is considered a food use and could result in potential dietary exposure. Therefore, it the absence of appropriate tolerances cancellation of the use is proposed.

If the registration of this coal tar product was continued with amended terms and conditions, the following provision would apply: all applicators would be required to wear respirators and impermeable gloves and be certified. Dermal and inhalation exposure and subsequent health risks would be reduced. However, tolerances would still need to be established. The provisions of Option 2 are expected to have minimal impact on the economic benefits.

If the registration of this coal tar product was cancelled for this use, all risks to applicators would be eliminated as well as any potential dietary exposure. Cancellation of this use would not have a significant economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of coal-tar products, the Agency has determined that the risks outweigh the benefits for Options 1 and 2. Therefore, the Agency proposes to cancel the use of the coal-tar products for use as disinfectants in seed potato storage premises and on equipment.

6. Livestock Premises

If the registrations of coal-tar containing products for use as disinfectants in livestock premises were continued without restriction, applicators would continue to be exposed to these chemicals. These products are applied by spray, or are wiped or mopped onto surfaces. Usage data are not available due to the fact that these products are purchased over-the-counter by individual livestock farmers and use patterns vary regionally depending on the type of livestock in a specific area. There are several alternatives to the coal tar products available. The benefits associated with this use are not significant.

If registrations of coal-tar containing products were continued with amended terms and conditions, the following provision would apply: all applicators would be required to be certified and wear respirators and impermeable gloves. Exposure and subsequent health risks would be reduced but the risks would still outweigh the benefits for this use.

If registrations of coal tar-containing products for this use were cancelled, all risks to the applicators from these products would be eliminated. Cancellation of this use would not a significant economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of coal-tar products, the Agency has determined that the risks outweigh the benefits for Options 1 and 2. Therefore, the Agency proposes to cancel the use of the coal-tar products for use as disinfectants in livestock premises.

7. Poultry Premises

Disinfectants containing creosote, coal tar and coal tar neutral oils are registered for use on poultry premises. The use of these products has consistently diminished since 1971 when EPA cancelled the registrations of coal tar neutral oil/coal tar acid combination products used in poultry houses. If registrations of these products were continued without restriction, applicators would continue to be exposed to these chemicals. Since several alternative chemicals are available, the benefits associated with this use are not significant.

If registrations of coal tar-containing products were continued with amended terms and conditions, the following provision would apply: all applicators would be required to be certified and wear respirators and impermeable gloves. Exposure and subsequent health risks would be reduced but the risks would still outweigh the benefits for this use.

If registrations of coal tar-containing products for this use were cancelled, all risks to the applicators and homeowners from these products would be eliminated. Cancellation of this use would have no economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of the coal tar products, the Agency has determined that the risks outweigh the benefits for Options 1 and 2. Therefore, the Agency proposes to cancel the use of the coal tar products for use as disinfectants in poultry premises.

8. Home and Institutional Use

Several products containing creosote, coal tar, and coal tar neutral oil are registered as disinfectants for home and institutional use. If the registrations of these products were continued without restriction, both commercial applicators and homeowners would continue to be exposed to these chemicals. Usage data are not available but the benefits associated with the continued use are insignificant. Several alternative chemicals are available.

If registrations of coal tar-containing products were continued with amended terms and conditions, the following provision would apply: all applicators would be required to be certified and wear respirators and impermeable gloves. Exposure and subsequent health risks would be reduced but the risks would still outweigh the benefits for this use.

If registrations of coal tar-containing products for this use were cancelled, all risks to the applicators and homeowners from these products would be eliminated. Cancellation of this use would not have a significant economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of the coal tar products, the Agency has determined that the risks outweigh the benefits for Option 1 and 2. Therefore, the Agency proposes to cancel the use of the coal-tar products for use as disinfectants in home and institutional settings.

9. Transportation Vehicles

Products containing creosote, coal tar, and coal tar neutral oils are used in transportation vehicles to disinfect tables, seats, walls, toilets, and sinks. There is no currently reported use of these products at these sites. If the registrations of these products were continued without restriction, applicators would continue to be exposed dermally to these chemicals. There are alternative chemicals available.

If the registration of this use were allowed to remain with amended terms and conditions, the following provisions would apply: all applicators would be required to be certified and to wear respirators and impermeable gloves. Exposure and subsequent health risks would be reduced but the risks would still outweigh the benefits.

If the registration of this use were cancelled, all possible risks to the applicator from this product would be eliminated. Cancellation of this use would have no economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of creosote, coal tar, and coal tar neutral oil, the Agency has determined that the risks outweigh the benefits for Options 1 and 2. Therefore, the Agency proposes to cancel the use of these products for use as disinfectants in transportation vehicles.

10. Tree Wound Dressings

A creosote product is currently registered for use as a tree wound dressing to prevent decay in damaged trees. If the registration of this product were continued without restriction, applicators would continue to be exposed dermally to this chemical. There are alternative chemicals available and the value of tree dressing is questionnable. There are no benefits associated with this use.

If the registration of this creosote product were continued with amended terms and conditions, the following provision would apply: all applicators would be required to be certified and wear impermeable gloves. Exposure and subsequent health risks would be reduced but the risks would still outweigh the benefits for this use.

If the registration of this creosote product for this use were cancelled, all risks to the applicators from this product would be eliminated. Cancellation of this use would have no economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of creosote products, the Agency has determined that the risks outweigh the benefits for Options 1 and 2. Therefore, the Agency proposes to cancel this use of creosote for use on tree wounds.

11. Metalworking Fluids

One product containing coal tar acids, coal tar phenols, cresylic acids, and creosote is registered for use a bactericide-fungicide in metalworking fluids. As of 1980, there has be no production or sale of this product. However, since the product is still registered, regulatory options must be considered. If usage of this product resumed, applicators would be exposed to creosote/coal tar and at risk to cancer and mutagenic effects. Alternative chemicals are available for this use. There are no known benefits associated with the continued registration of this product.

If registration of this use were allowed to remain with amended terms and conditions, the following provisions would apply: all applicators would be required to be certified and wear impermeable gloves. Exposure and subsequent health risks would be reduced but the risks would still outweigh the benefits.

If the registration of this creosote/coal tar product were cancelled, all possible risks to the applicator from this product would be eliminated. Cancellation of this use is not thought to have any economic impact since the product is not currently used or marketed.

Having evaluated the cancer and mutagenic risk associated with the use of this creosote/coal-tar product, the Agency has determined that the risks outweigh the benefits for Options 1 and 2. Therefore, the Agency proposes to cancel the use of this creosote/coal tar product for use as a bactericide-fungicide in metalworking fluids.

12. Mosquito Larvicide

If registrations of neutral oil coal-tar acids for use in the control of mosquito and fly larvae were continued without restriction, applicators would be exposed via spray treatment or during the spraying of the chemical onto the surface of stagnant waters. These products have not been used for this purpose for many years since more effective altenatives are available. Therefore, there are no benefits associated with the continued use of this product.

If registration of this use were allowed to remain with amended terms and conditions, the following provisions would apply: all applicators would be required to be certified and to wear respirators and impermeable gloves. Exposure and subsequent health risks would be reduced but the risks would still outweigh the benefits.

If the registrations of neutral oil coal-tar acid products were cancelled, all possible risks to the applicator from this product would be eliminated. Cancellation of this use would have no economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of neutral oil coal-tar acid products, the Agency has determined that the risks outweigh the benefits for Options 1 and 2. Therefore, the Agency proposes to cancel the use of these products for use as larvicides to control mosquito larvae.

13. Animal Repellents

Creosote, coal tar, and neutral oil products are registered for use on lawns and flower beds to discourage the use of these areas by dogs and on wooden structures to prevent horse. cribbing. If registrations of these products were continued without restriction for use as animal repellents, applicators would continue to be exposed to these chemicals and be at risk to cancer and mutagenic effects. There are no alternatives to the use of these products on stalls and wooden fences to prevent horse cribbing except for another coal tar distillate product, anthracene oil.

If registrations of these products were continued with amended terms and conditions, the following provisions would apply: all applicators would be required to wear impermeable gloves and have to be certified. Exposure and subsequent health risks would be reduced. The provisions of Option 2 are expected to have minimal economic impact.

If registrations of these products were cancelled for this use, all risks to applicators would be eliminated. Cancellation of this use would not have a significant economic impact.

Having evaluated the cancer and mutagenic risk associated with the use of coal tar-containing products to prevent dogs from use of lawns and flower beds and horses from cribbing on wooden structures, the Agency has determined that the risks outweigh the benefits for Options 1 and 2. Therefore, the Agency proposes to cancel this use of the creosote products.

14. Bird Repellent

Coal tar products are used in treating seed to prevent or discourage the ingestion of seed by birds, particularly crows. If registration of the coal tar products for this use were allowed to continue without restriction, applicators would continue to be exposed and at risk to cancer and mutagenic effects. Alternative chemicals are available.

If registrations of these products were continued with amended terms and conditions, the following provisions would apply: all applicators would be required to be certified and wear impermeable gloves and a respirator. Exposure and subsequent health risks would be reduced but potential dietary exposure would remain a problem. The provisions of Option 2 are expected to have minimal impact on the economic benefits.

If registrations of these products were cancelled for this use, all risks to applicators would be eliminated and there would be no potential dietary exposure. Cancellation of this use would not have a significant economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of coal tar-containing products, the Agency has determined that the risks outweigh the benefits in Options 1 and 2. Therefore, the Agency proposes to cancel the use of the coal tar products for use as bird repellents.

15. Insect Repellent

Coal tar is currently registered as an insect repellent. If registration of the coal tar products for this use were allowed to continue without restriction, applicators would continue to be exposed and at risk to cancer and mutagenic effects. There are many highly effective alternative products registered for this use. There is no evidence to indicate that the coal tar product is still produced and marketed for use as an insect repellent. There are no benefits associated with the continued registration of this product.

Option 2 allows the registration of these products to continue with amended terms and conditions that applicators be certified and wear protective clothing. However, for this use protective clothing would be impractical since the product is actually applied to human skin. There are no other amended terms and conditions to the registration for this use that would reduce exposure.

If registrations of these products were cancelled for this use, all risks to applicators woull be eliminated. Cancellation of this use would have no economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of coal tar-containing products, the Agency has determined that the risks outweigh the benefits in Options 1 and 2. Therefore, the Agency proposes to cancel the use of the coal tar products for use as an insect repellent.

16. Screwworm Control

There is one creosote product currently registered for treatment of screwworms in horses and mules. Actual use of this product cannot be verified. If registration of the coal tar products for this use were allowed to continue without restriction, applicators would continue to be exposed and at risk to cancer and mutagenic effects. Several alternative chemicals are available for this use. There are no benefits associated with the continued registration of this product.

If the registration of this creosote product were continued with amended terms and conditions, the following provisions would apply: all applicators would be required to be certified and wear impermeable gloves. Exposure and subsequent health risks would be reduced but the risks would still outweigh the benefits for this use.

If the registration of this creosote product were cancelled for this use, all risks to the applicators from this product would be eliminated. Cancellation of this use would have no economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of creosote, the Agency has determined that the risks outweigh the benefits for Options 1 and 2. Therefore, the Agency proposes to cancel the use of creosote for use on horses and mules for screwworm control.

17. Insect Control

If registrations of coal tar products and neutral oil products registered as larvicides and disinfectants for use to control maggots and flies in garbage trucks and flies in drain lines were continued without restriction, applicators would continue to be exposed to these chemicals and at risk to cancer and mutagenic effects. There are several alternatives available for this use. The benefits associated with this use are not significant.

If the registrations of coal tar and neutral oil products were continued for this use with amended terms and conditions, the following provision would apply: all applicators would be required to be certified and wear respirators and impermeable gloves. Exposure and subsequent health risks would be reduced but the risks would still outweigh the benefits for this use.

If the registrations of these coal tar and neutral oil products were cancelled for this use, all risks to the applicators from this product would be eliminated. Cancellation of this use would have no economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of these products, the Agency has determined that the risks outweigh the benefits for Option 1 and 2. Therefore, the Agency proposes to cancel the use of these products for use to control maggots and flies in garbage trucks and drain lines.

18. Gypsy Moth Control

Neutral oil-containing products and creosote are used in gypsy moth control, specifically on gypsy moth egg masses. If registrations of these products were continued without restriction, applicators would continue to be exposed to these chemicals and at risk to cancer and mutagenic effects. There are no registered alternatives to the neutral oil/creosote-containing products. Usage of these products is reported to be minimal.

If the registrations of neutral oil/creosote-containing products were continued for this use with amended terms and conditions, the following provision would apply: all applicators would be required to be certified and wear impermeable gloves. Exposure and subsequent health risks would be reduced. The provisions of Option 2 are expected to have minimal impact on the economic benefits.

If the registrations of these coal tar and neutral oil products were cancelled for this use, all risks to the applicators from this product would be eliminated. Cancellation of this use would have a minor economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of neutral oil/creosote-containing products, the Agency has determined that the risks outweigh the benefits for Options 1 and 2. Therefore, the Agency proposes to cancel the use of these products for use on gypsy moth egg masses.

19. Animal Dip

Coal tar distillates, including coal tar are registered for use as disinfectants to control parasites, such as ticks, on non-food animals. If registrations of these products were continued without restriction, applicators would continue to be exposed to these chemicals and at risk to cancer and mutagenic effects. There are numerous alternatives registered

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of use to control lice, fleas, ticks, and mites on non-food animals. The benefits associated with the continued use of these products are insignificant.

If the registrations of products containing coal distillates were continued for this use with amended terms and conditions, the following provision would apply: all applicators would be required to be certified and wear impermeable gloves. Exposure and subsequent health risks would be reduced but the risks would still outweigh the benefits for this use.

If the registrations of the coal tar distillate products were cancelled for this use, all risks to the applicators from this product would be eliminated. Cancellation of this use would no economic impact.

Having evaluated the cancer and mutagenic risk associated with this use of coal distillate-containing products, the Agency has determined that the risks outweigh the benefits for Options 1 and 2. Therefore, the Agency proposes to cancel the use of the coal distillates products for use as an animal dip.

B. Summary of Proposed Regulatory Decision

1. Ornamental flowering plants and ornamental lawns

   Option 3. Cancel registrations.

2. Product storage yards

   Option 3. Cancel registrations.

3. Agricultural premises and highway rights-of-way

   Option 3. Cancel registrations.

4. Rope and Canvas Tarpaulins

   Option 3. Cancel registrations.

5. Seed Potato Storage Premises and Equipment

   Option 3. Cancel registrations.

6. Livestock Premises

   Option 3. Cancel registrations.

7. Poultry Premises

   Option 3. Cancel registrations.

8. Home and Institutional Use

   Option 3. Cancel registrations.

9. Transportation Vehicles

   Option 3. Cancel registrations.

10. Tree Wound Dressings

    Option 3. Cancel registrations.

11. Metalworking Fluids

Option 3. Cancel registrations.

12. Mosquito Larvicide

Option 3. Cancel registrations.

13. Animal Repellents

Option 3. Cancel registrations.

14. Bird Repellent

Option 3. Cancel registrations.

15. Insect Repellent

Option 3. Cancel registrations.

16. Screwworm Control

Option 3. Cancel registrations.

17. Insect Control

Option 3. Cancel registrations.

18. Gypsy Moth Control

Option 3. Cancel registrations.

19. Animal Dip

Option 3. Cancel registrations.

PART VI: BIBLIOGRAPHY

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